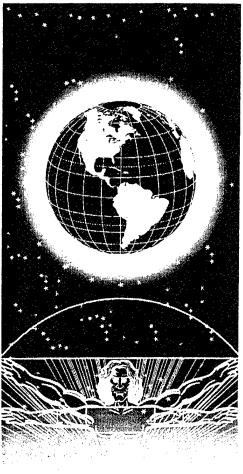
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UNITED STATES AIR FORCE IERA

Aircraft Engine and Auxiliary Power Unit Emissions Testing: Final Report Addendum F119-PW-100 Engine Emissions Testing Report

Thomas Gerstle

Environmental Quality Management, Inc. 1310 Kemper Meadow Drive, Suite 100 Cincinnati, OH 45240

Peter Virag

Roy F. Weston, Inc. 1400 Weston Way West Chester, PA 19380

Mark D. Wade

Karta Technology, Inc. 5555 N.W. Parkway San Antonio, TX 78245

Phillip P. Brown, Major, USAF, BSC

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June 2002

Air Force Institute for Environment, Safety and Occupational Health Risk Analysis Risk Analysis Directorate Environmental Analysis Division 2513 Kennedy Circle Brooks Air Force Base TX 78235-5116

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PHILLIP P. BROWN, Major, USAF, BSC Technical Project Manager

LYNN L. BORLAND, Lt Col, USAF, BSC Chief, Environmental Analysis Division

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TABLE OF CONTENTS

Section		Page
Preface		ü
Appendices Figures Tables		v vi vii
Executive S	ummary	1 of 8
1.0	Introduction 1.1 Previous Studies 1.2 Background 1.3 Project Objectives 1.4 Current Testing Program 1.4.1 F119-PW-100 1.4.2 Test Facility	1 of 5 1 of 5 2 of 5 4 of 5 5 of 5 5 of 5 5 of 5
2.0	 Facility and Sampling Apparatus Description 2.1 Lockheed Martin Aeronautical Systems (LMAS) Test Facility Overview 2.2 Engine Exhaust Sampling Rake System 2.3 Augmentor Tube Slipstream Sampling System 	1 of 17 1 of 17 2 of 17 2 of 17
3.0	 Sampling Procedures and Methods 3.1 General Sampling Considerations/Complications 3.1.1 Pollutant Distribution in the Augmentor Tube 3.2 Emission Testing 3.2.1 Flow Rate Measurement 3.2.2 Pretest Measurements 3.2.3 Emissions Test Methods 3.2.4 Ambient Air Sampling 3.2.4.1 Particulates 3.2.4.2 Volatile Organic Compounds 3.2.4.3 Carbon Monoxide and Nitrogen Oxides 3.3 Engine Test Cycle Data 3.4 JP-8 Fuel Sampling and Analysis 3.5 Engine Testing Matrix 3.5.1 Engine Shakedown Runs 3.5.2 Engine Testing 3.5.3 Engine Emission Trend Development 	1 of 22 2 of 22 4 of 22 6 of 22 7 of 22 11 of 22 12 of 22 12 of 22 13 of 22 15 of 22 15 of 22 16 of 22 16 of 22 18 of 22

TABLE OF CONTENTS (continued)

.

	3.6	Emission Test Schedule	18 of 22
		3.6.1 Personnel Responsibilities	21 of 22
4.0	Calcu	ulation of Airflow	1 of 12
	4.1	Calculation of Exhaust Airflow using Tracer Gas	1 of 12
		4.1.1 Tracer Gas Methodology	1 of 12
		4.1.2 Sampling for SF ₆ and Determining a Homogeneous	
		Exhaust Mixture	4 of 12
		4.1.3 Determination of Average SF ₆ Concentration	4 of 12
•		4.1.4 Evaluation of Average SF ₆ Concentration	5 of 12
		4.1.5 Use of SF ₆ Concentration to Adjust Other Sample	•
		Results	5 of 12
	4.2	Calculate of Inlet and Outlet Airflow Using a Carbon	
		Balance	5 of 12
	4.3	Calculation of Airflow Using F-Factor	9 of 12
	-1.0		
5.0	Quali	ty Assurance Procedures	1 of 20
	5.1	Quality Control Procedures	1 of 20
		5.1.1 Field QC Sample Collection/Preparation	
		Procedure	1 of 20
		5.1.1.1 QC Procedures for Stack Gas Sample	
		Collection	3 of 20
		5.1.1.2 Velocity/Volumetric Flow Rate QC	
		Procedures	3 of 20
		5.1.1.3 Moisture Content and Sample Volume	
		QC Procedures	4 of 20
		5.1.2 Exhaust Gas Blank Sample	5 of 20
	5.2	Sampling Containers, Preservatives, and Volume	
		Requirements	6 of 20
	5.3	Decontamination Procedures	6 of 20
	5.4	Sampling Packaging and Shipment	8 of 20
	5.5	Custody Procedures	9 of 20
		5.5.1 Field Custody Procedures	9 of 20
	5.6	Calibration Procedures and Frequency	13 of 20
		5.6.1 Field Instrument Calibration	13 of 20
	5.7	Data Reduction, Validation, and Reporting	13 of 20
		5.7.1 Data Reduction	14 of 20
		5.7.1.1 Field Data Reduction Procedures	14 of 20
		5.7.1.2 Office Calculations	14 of 20
		5.7.2 Analytical Data Validation Evaluation	17 of 20
		5.7.2.1 Procedures Used to Evaluate Field Data	17 of 20
		5.7.3 Data Reporting	18 of 20
		5.7.3.1 Field Data Reporting	18 of 20

TABLE OF CONTENTS (continued)

	5.8 Preventative Maintenance Review	18 of 20
	5.8.1 Field Instrument Preventative Maintenance	18 of 20
	5.9 Corrective Action	19 of 20
6.0	Results	1 of 36
	6.1 Gaseous Pollutants	2 of 36
	6.1.1 Shakedown Runs	2 of 36
	6.1.2 Gaseous Emission Factors	4 of 36
	6.2 Volatile Organic Compounds	5 of 36
	6.2.1 Speciated Pollutant Comparison	6 of 36
	6.3 Aldehyde and Ketones	6 of 36
	6.4 Pollutant Mixing in the Augmentor Tube	7 of 36
	6.5 Particulate Matter	8 of 36
	6.5.1 Particle Characterization	11 of 36
	6.6 Exhaust Flow Determination	12 of 36
	6.7 Fuel Analysis	12 of 36
	6.8 Engine Operation	12 of 36

APPENDICES

A Raw Field Data

B Particulate Analytical Results

FIGURES

<u>Number</u>		Page
2-1	Overview of Hush House Physical Layout	6 of 17
2-2	Overview of Hush House Layout	7 of 17
2-3	Engine Mounted for Testing in Hush House	8 of 17
2-4	Exhaust Deflector Plate	9 of 17
2-5	Rake Assembly	10 of 17
2-6	Engine Sampling Rake	11 of 17
2-7	Augmentor Tube Side-Stream Sampling System (Elevation View)	12 of 17
2-8	Augmentor Tube Side-Stream Sampling System (Plan View)	13 of 17
2-9	Augmentor Tube Sampling Rake (View from Test Engine)	14 of 17
2-10	Orthogonal View of Slip-Stream Sampling Apparatus	15 of 17
2-11	Augmentor Tube Side-Stream Extraction Tube and Gas Sampling	16 of 17
2-12	Augmentor Tube Side-Stream Sampling System Duct	17 of 17
3-1	Time-Line for F119-PW-100 Engine Testing at the Lockheed Martin Aeronautical Systems	20 of 22
6-1	Augmentor Tube Sampling Rake (View from Test Engine)	13 of 36

TABLES

<u>Number</u>		<u>Page</u>
111-1	Criteria Pollutant Summary	7 of 8
111-2	Air Pollutant Summary	8 of 8
1-1	U.S. Military Specifications of Turbine Fuels, JP-8 USAF MIL-T-83133A-AMD.1; 4 April 1980; Kerosene or JP-8	3 of 5
3-1	Summary of Source Target Compounds for Volatile Organic Compounds	9 of 22
3-2	Summary of Source Target Metals from JP-8 Fuel Analysis	11 of 22
3-3	Summary of Ambient Target Compounds for Volatile Organic Compounds	14 of 22
3-4	JP-8 Fuel Analysis Requirements	16 of 22
3-5.	Engine Emission Sampling Matrix	19 of 22
3-6	Example Breakout of Field Team Personnel and Responsibilities	22 of 22
5-1	Summary of Analytical QA/QC Samples	2 of 20
5-2	Recommended Sample Containers, Preservation Techniques, and Holding Times	7 of 20
5-3	Legend for Sample Identification System	12 of 20
5-4	Activity Matrix for Calibration of Equipment	15 of 20
6-1	Gaseous Emissions Summary – 10% Power Setting	14 of 36
6-2	Gaseous Emissions Summary – 20% Power Setting	15 of 36
6-3	Gaseous Emission Summary – 70% Power Setting	16 of 36
6-4	Gaseous Emission Summary – 100% Power Setting	17 of 36
6-5	Gaseous Emission Summary – 150% Power Setting	18 of 36

TABLES (continued)

6-6	Gaseous Emissions Summary – Various Power Settings Slipstream Rake	19 of 36
6-7	Slipstream Rake – Emission Factor Summary	20 of 36
6-8	Engine Rake Emissions Factory Summary	21 of 36
6-9	Emissions Factor Summary – Volatile Organic Compound (VOCs) – Idle	22 of 36
6-10	Emissions Factor Summary – Volatile Organic Compound (VOCs) – Approach	23 of 36
6-11	Emissions Factor Summary – Volatile Organic Compound (VOCs) – Intermediate	24 of 36
6-12	Emissions Factor Summary – Volatile Organic Compound (VOCs) – Military	25 of 36
6-13	Emissions Factor Summary – Slipstream Duct (Aldehyde/Ketones)	26 of 36
6-14	Emissions Factor Summary – Engine Rake – Benzene	27 of 36
6-15	Emissions Factor Summary – Engine Rake – Aldehyde/Ketones	28 of 36
6-16	Slipstream Rake Intake – Sample Point Data Comparison	29 of 36
6-17	Emissions Factor Summary – Particulates – Idle	30 of 36
6-18	Emissions Factor Summary – Particulates – Approach	31 of 36
6-19	Emissions Factor Summary – Particulates – Intermediate	32 of 36
6-20	Emissions Factor Summary – Particulates – Military	33 of 36
6-21	Particle Size Distribution	34 of 36
6-22	Fuel Metals Analysis	35 of 36
6-23	Engine Operation Summary	36 of 36

Test Report Executive Summary Revision 1 June 2002 Page 1 of 8

EXECUTIVE SUMMARY

I.0 INTRODUCTION

The U.S. Air Force is developing a new fighter bomber designated as the F-22, Raptor. The aircraft will be equipped with two F119-PW-100 augmented turbofan engines. To evaluate the potential impacts of this aircraft on ambient air quality, AFIERA/RSEQ with the assistance of the F-22 Systems Program Office characterized emissions from the F119-PW-100 engine. The emission tests were conducted at the Lockheed Martin Marietta, Georgia, facility in a government-owned hush house. During the emission test, Pratt & Whitney operated the engine.

The results from this test and other emission test programs will be used to evaluate potential environmental impacts that may be created by the bed down of the aircraft at various Air Force Bases.

I.1 Objectives

The purpose of this engine emissions testing program was to develop emission factors for the F119-PW-100 engine under representative engine load conditions. All testing was performed by the Environmental Quality Management Inc. (EQ) and Roy F. Weston, Inc. (Weston) team. Testing was conducted for criteria pollutants and select hazardous air pollutants (HAPs), e.g., aldehyde/ketones and volatile organic compounds.

II. 0 SAMPLING METHODOLOGY

Sampling was performed for criteria pollutants and those HAPs that are products of incomplete combustion (PICs). Environmental Protection Agency (EPA) emissions test methods (Title 40, Code of Federal Regulations, Part 60, Appendix A) were followed during this test program. The test methods were modified where necessary due to the unique circumstances encountered during the program: i.e., high flow rates, unique exhaust configuration, and a large volume of dilution (ambient) air in the exhaust gas stream. A custom EPA Method 5 was used due to the physical configuration of the

Test Report Executive Summary Revision 1 June 2002 Page 2 of 8

test cell. The nature of the location did not permit a full cross-section traverse; instead, single point sampling was performed via a slipstream. A verification was made through the use of tracer gas that the sample point was representative of the entire exhaust stream. The following is a list of the constituents of the exhaust stream that were measured along with the corresponding EPA test methods used:

- Filterable and condensable particulate (EPA Methods 5 and 202).
- Aldehydes and ketones (EPA 0011¹ and TO-05).
- Volatile organic.compounds (VOCs) (EPA Method 0030).
- Oxygen and carbon dioxide (EPA Method 3A).
- Carbon monoxide (EPA Method 10).
- Nitrogen oxides (EPA Method 7E).
- Non-methane hydrocarbons (NMHCs) (EPA Method 25A).

Sampling was not performed for sulfur dioxide and metals in the engine exhaust streams. Historic testing of metals provided random results with a number of interferences. Sulfur dioxide emissions were reported based on the procedure documented by AFIERA. This procedure estimates that sulfur dioxide emissions can be estimated by assuming all sulfur in the fuel undergoes complete oxidation to SO₂. The emission factor for SO₂ is provided in this report. JP-8 fuel samples were also collected for metals analysis. Dioxins/furans and other HAPs not listed in this report would not have been emitted in significant quantities to be readily detected by conventional sampling methods. Therefore, these compounds were not part of the emissions testing program.

Ambient air samples were collected and analyzed to correct for background conditions and thus reduce any potential bias. Ambient air samples were analyzed for many of the same compounds found in the exhaust stream. Ambient air samples were collected concurrent with emissions testing to account for emissions from large nearby sources (e.g., exhaust from other test cells) having the potential to bias the test results.

Ambient samples were collected for the following compounds:

From EPA SW-846.

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Test Report Executive Summary Revision 1 June 2002 Page 3 of 8

- Particulate TSP (40 CFR, Part 60, Appendix B).
- Semivolatiles (EPA Method TO-13).
- VOCs (EPA Method TO-14).
- CO₂ (EPA Method 3A)
- CO (EPA Method 10)
- NO_x (EPA Method 7E)

During the sampling program, ambient pollutant concentrations were subtracted from source concentrations to account for background levels. During the program, background concentrations of pollutants were generally in the <1 to 20 percent range when compared to source concentrations. Background concentrations were highly dependent on local background sources.

II.1 Engine Testing Considerations/Complications

The engine was tested at five actual flight settings. Nominal engine conditions for emissions sampling are provided below:

- Idle (I), 10% power
- Approach (A), 20% power
- Intermediate (N), 70% power
- Military (M), 100% power
- Afterburner (AB), 150% power

Emissions tests comprised three 1-hour sampling runs for each pollutant at each power setting with the exception of the aldehydes/ketones tests. Due to sample volume requirements needed to meet method detection limits, aldehydes/ketones were collected over a 3-hour sampling period. Only two test runs were conducted at intermediate and military. The F119-PW-100 could not be operated continuously at military or afterburner maximum power for one continuous hour in order to prevent engine and/or test cell damage. The sample run time in the higher operative modes was reduced to a "safe" operating period. The sample collection procedures were reduced to accommodate the reduced operating time. In order to reach the analytical detection limit for the target pollutants, the sample team paused the sample run at the end of the safe operating period, waited as the engine was allowed to cool, then resumed sampling for the next operating period until the 1-hour sample run was

Test Report Executive Summary Revision 1 June 2002 Page 4 of 8

completed. At the afterburner setting, a single 10-minute sample run was conducted for gaseous pollutants only.

III.0 RESULTS

III.1 Criteria Pollutants

Results of the gaseous emissions testing are presented in Table III-1. The tables present both emission rates and factors for NO_x , CO, total particulate, NMHC, and CO_2 for each engine at each engine test condition. The emissions presented are the average of three 1-hour sampling runs. Results of individual runs are presented in Section 6 of this report.

III.2 Hazardous Air Pollutants

Table III-2 depicts the average HAP emissions for each power setting. These tables combine and summarize volatile and aldehyde/ketones compounds. The 10 HAPs shown in Table III-2 are the most frequently detected HAPs that are combustion by-products. Within this table, HAPs have been totaled for each power setting. The remaining HAP data that was analyzed during this sampling program is presented in Section 6 of this report.

IV.0 CONCLUSIONS

The following conclusions pertain to future engine testing and data analysis. During the testing program over 120 individual compounds were sampled and analyzed, but only a small percentage of those compounds was detected repeatedly. Those compounds that were detected had concentrations significantly above the analytical detection levels. Depending on the use of this data, it may be justifiable to reduce the compounds sampled in subsequent programs to only those compounds that were detected during this program. This is based on the assumption that sufficient HAP data was gathered during this program that can be directly applied to future engines. Any future sampling must take into account what the potential use of the data may be

Test Report Executive Summary Revision 1 June 2002 Page 5 of 8

(health risk, HAP qualification/quantification, regulatory, etc.) and then determine what compounds need to be sampled.

Likewise if similar test methodologies, as applied during this program, are used to collect and analyze for various compounds, no significant cost savings would be achieved in reducing the number of compounds analyzed for in a specific test method (i.e., sampling for VOCs by EPA method 0030 and only analyzing for benzene, toluene, and xylene). If sampling is conducted by an alternate method requiring significantly less effort to collect the sample and analyze for fewer compounds, a significant cost savings may be achieved.

The data collected during this program can also be reviewed to determine if surrogate compounds can be used to predict other HAPs (i.e., can benzene be used to predict formaldehyde). Based on the data currently available, however, there are not sufficient data points at each engine conduction to do a meaningful analysis. If additional data was available, primarily at those engine conditions that have the highest emission rates, a statistically significant analysis could be conducted.

- Benzene, toluene, and xylene represent the most significant VOCs measured during the program.
- Formaldehyde surrogate for aldehydes group. Formaldehyde accounts for over 90% of total aldehydes/ketones. Future sampling should only be done for formaldehyde.
- Most HAP emissions occur during the idle and engine setting. Future testing should concentrate on these modes to characterize emissions.
- An alternative particle sampling methodology is necessary. Using EPA Method 5 in an attempt to meet regulatory testing requirements is not necessary. The sampling environment is at or below the Method 5 detection limit.
- The particles are predominately less than 2.5 microns in size (range from 70% 80% of the total particles). As the fuel firing rate increases, the percentage of particles less than 2.5 microns also increases. These particles are primarily carbon soot. The larger particles, 2.5 to 10 microns, were found to be agglomerates of smaller combustion particles. These agglomerates accounted for 4.1% to 10.8% of the particle total. The largest particles, 7.5 to

Test Report Executive Summary Revision 1 June 2002 Page 6 of 8

10+ microns, were found to be angular particles that are believed to have been cooled and deposited on a surface and suspended during the test program. These particles are not considered a combustion product during testing. These particles ranged from 0.7 to 4.3% of the particle total. Test Report Executive Summary Revision 1 June 2002 Page 7 of 8

TABLE III-1 F119-PW-100 CRITERIA POLLUTANT SUMMARY

•		idle	Apı	Approach	Intern	Intermediate	IIIM	Military	After	Afterburner
Exhaust Flow,										
dscfm	28	289029	99	663582	726	97449	1294	1294958	182	1821290
						lbs/1000		lbs/1000		lbs/1000
		lbs/1000 lbs		lbs/1000 lbs		lbs		lbs		lbs
	lb/hr	fuel	lb/hr	fuel	lb/hr	fuel	lb/hr	fuel	lb/hr	fuel
NOx ^a	4.1	3.0	18.1	6.6	125.4	12.4	368.8	19.8	369.8	7.4
co	66.3	48.2	21.7	7.9	21.6	2.1	14.0	0.8	807.7	16.1
NMHC	9.4	6.8	0.9	0.3	5.3	0.5	0.0	0.0	9.3	0.2
Total										
Particulate	3.43	2.49	5.49	2.00	14.24	1.41	20.92	1.12	(c)	(c)
a = Reported as NO ₂	NO ₂									
b = Total Non-Methane Hydrocarbons	ithane Hydro	carbons								
c = Particulate sampling not conducted at afterburner	ampling not	conducted at a	ifterburner	1						
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Test Report Executive Summary Revision 1 June 2002 Page 8 of 8

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TABLE III-2 F119-PW-100 HAZARDOUS AIR POLLUTANT SUMMARY

	4	ldle	App	Approach	Intern	Intermediate	W	Military
Exhaust Flow, dscfm	39	289029	8 B	663582	1/6	97449	120	1294958
		lbs/1000		lbs/1000		lbs/1000		
		sdl		lbs		lbs		lbs/1000 lbs
Pollutant	lb/hr	fuel	lb/hr	fuel	lb/hr	fuel	lb/hr	fuel
Formaldehyde	1.3740	0.9978	0.0975	0.0356	0.2473	0.0245	0.1413	0.0076
Acetaldehyde	0.1527	0.1109	0.0185	0.0068	0.0264	0.0026	0.0155	0.008
Acrolein	0.0496	0.0360						
lsobutyraldehyde / MEK ^a	0.0916	0.0665						
Benzene	0.1453	0.1055	0.0091	0.0033	0.0069	0.007	0.0091	0.0005
Toluene	0.0877	0.0637	0.0007	0.0003				
Ethylbenzene	0.0226	0.0164	0.0012	0.0004	0:00:0	0.0005	0.0034	0.0002
<u>m,p - Xylene</u>	0.0539	0.0391	0.0015	9000.0			0.0057	0.0003
o-Xylene	0.0384	0.0279	0.0009	COOO:0	0.0049	0.0005	0.0031	0.0002
Styrene	0.0430	0.0312	0.0012	0.0004				
Total HAPs	2.0587	1.4950	0.1307	27477	0.2906	0.0287	0.1781	9600.0
a - Analytical "peaks" overlap preventing determination of a single compound.	enting deterr	nination of a	single com		ult could be	either comp	ound or col	Result could be either compound or combination of b
Blanks represent a non-detect value.	e.							
A MARINA DA			,					

Test Report Section 1 Revision 1 June 2002 Page 1 of 5

SECTION 1

INTRODUCTION

This Emission Summary Scientific and Technical Report has been prepared by Environmental Quality Management, Inc. (EQ) under Delivery Order 0008 of the Occupational and Environmental Health Assessments Contract (Contract Number F41624-95-D-9019) supporting the Air Force Occupational and Environmental Health programs around the world. This contract is administered by the Air Force Institute for Environment, Safety, and Occupational Health Risk Analysis/Risk Analysis Environmental Quality (AFIERA/RSEQ), Brooks Air Force Base (AFB), Texas,

The project requirements are described in the delivery order and its attached Statement of Work and Contract Data Requirements Lists (CDRL's).

The project includes:

- Preparation of the SAP (submitted August 2000, A004).
- Preparation of the Site Survey Report (submitted 6 April 2000, A011).
- Preparation of monthly progress, status, and management reports (A001).
- Preparation of conference agenda and minutes (A008).
- Preparation of a summary Scientific and Technical Report (this document, A003).

A description of the project background and objectives is provided in this section.

1.1 PREVIOUS STUDIES

The USAF began to develop a database of known engine emissions data in the 1970s. The purpose of developing the database was to produce a catalog of smoke plume opacity and gaseous emissions from engine test facilities. Environmental managers could use data from the catalog to meet regulatory reporting requirements. Subsequently, the USAF and the U.S. Navy (USN) have attempted to amass and review existing engine emissions data, validate the data, and identify data gaps. The USAF's Engineering and Services Laboratory and Engineering Services Center, and the

Test Report Section 1 Revision 1 June 2002 Page 2 of 5

USN's Environmental Support Office have been the lead organizations for this effort. Available aircraft emissions technical references were compiled and reviewed by the U.S. Environmental Protection Agency (U.S. EPA) in 1993. The current effort is being undertaken by the USAF's AFIERA/RSEQ located at Brooks AFB, TX.

1.2 BACKGROUND

In 1973, the Defense Energy Task Force recommended that assertive action be taken to standardize U.S. Department of Defense (DOD) fuels. The Joint Logistics Coordinating Group, established to perform the standardization studies, recommended that the U.S. Air Force (USAF) replace naphtha-based JP-4 (MIL-T-5624) with the kerosene-based JP-8 (MIL-T-83133) as the standard turbine fuel. JP-8 is similar to commercial-grade jet engine fuel Jet A-1, with two additives previously required in JP-4. The hydrocarbon fuel is composed of various medium molecular weight organic compounds including paraffins, olefins, and aromatics. JP-8 specifications require a maximum olefin and aromatic content of 5% and 25% by volume, respectively. The maximum allowable sulfur content to meet the specifications of JP-8 is 0.3% by weight. The guaranteed minimum net heating content of the fuel is 18,400 Btu/lb. Table 1-1 lists the general specifications of JP-8 jet fuel. JP-8 fuel also contains several additives. Ethylene glycol monomethyl ether (EGME) is added as a fuel system icing inhibitor. Corrosion inhibitors and antistatic additives are also required to meet JP-8 specifications. Antioxidant and metal deactivator additives are optional for JP-8.

The principal reasons for replacing JP-4 with JP-8 were the following:

- Standardize military fuels with commercial aviation kerosene (Jet A-1).
- Be consistent with the ongoing standardization efforts in the North Atlantic Treaty Organization (NATO).
- Improve safety (JP-8 is less volatile than JP-4).
- Eliminate expenditures required for fuel evaporative equipment.

Test Report Section 1 Revision 1 June 2002 Page 3 of 5

TABLE 1-1. U.S. MILITARY SPECIFICATIONS OF TURBINE FUELS, JP-8 USAF MIL-T-83133A-AMD.1; 4 APRIL 1980; KEROSENE OR JP-8

Composition	(Acidity, Total; mg KOH/g)	0.015
	Aromatics	25.0
	Sulfur, Mercaptan; wt %	0.05
	Sulfur Total; wt %	0.3
	Color, Saybolt	0.3
Volatility	Residue; vol % for D-86	1.5
	Loss vol % for D-86	1.5
	Flash Point; ° C	38
	Gravity; ° API at 15° C	37-51
	Density; kg/m ³ at 15° C	775-840
Fluidity	Freezing Point; ° C (° F)	-50 (-58)
	Viscosity; cSt at -20° C	. 8.0
Combustion	Smoke Point	19.0
	Hydrogen Content; wt %	13.5
Stability	JFTOT delta P; mm HG	25
•	JFTOT Tube Color Code	< 3
Contaminants	Existent Gum; mg/100 ml	7
	Particulates; mg/liter	1
	Water Separation Index, Modified	70ª
Additives	Anti-icing; vol %	0.10 to 0.15
	Antioxidant	Option
	Corrosion Inhibitor	Required
	Metal Deactivator	Option
	Anti-static	Required
Other	Conductivity; pS/m	200 to 500
	Service	USAF
	NATO Code No.	F-34; F-35⁵

* With all additives except electrical conductivity additive.

^b Same as JP-8 without additives.

Source: Handbook of Aviation Fuel Properties, Coordinating Research Council, Inc., Society of Automotive Engineers, Inc. General Publications, Warrendale, PA 15096, 1983.

1.3 PROJECT OBJECTIVES

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Test Report Section 1 Revision 1 June 2002 Page 4 of 5

Although engine emissions from combustion of JP-4 are well documented for criteria pollutants,¹ little information exists for hazardous air pollutants (HAPs)² from combustion of JP-8 fuel. Due to intrinsic differences between these two raw fuels, their combustion products may differ. As part of a broader engine-testing program, the USAF, through the Human Systems Center (HSC) (now AFIERA/RSEQ) at Brooks Air Force Base, TX, contracted to have the emissions characterized from 17 aircraft engines, 2 helicopter engines, and 2 auxiliary power units (APUs) operating at a variety of settings. Criteria pollutants and targeted HAP emissions were quantified during the test program. Emission test results are used to develop emission factors for the aircraft engines and APUs tested. The USAF intends to develop a mathematical relationship. using the data collected during the previously completed tests and this sampling effort. to extrapolate existing JP-4 emission factors to representative JP-8 emission factors for the remaining untested engines. Past sampling events are detailed in Volumes 1, 2 and 3 of the Aircraft Engine and Auxiliary Power Unit Emissions Testing Final Report, EQ, 1998. This Addendum to that report details the testing program completed for the F119-PW-100 engine.

The overall focus of the program is to determine engine emissions from each test facility as the emissions exit to the atmosphere as opposed to directly behind the engine. The engine emission data from the test source will be utilized for engine "Bed Down" and conformity analysis for compliance with state implementation plans and federal implementation plans for the purpose of attaining or maintaining the national ambient air quality standards.

1.4 CURRENT TESTING PROGRAM

Criteria pollutants are pollutants for which National Ambient Air Quality Standards (NAAQS) (see 40 CFR 50) have been established. They include: carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, lead, and ozone (and its precursors).

Hazardous air pollutants (HAPs) are toxic chemicals and compounds regulated under Title III, Section 112(b) of the Clean Air Act Amendments of 1990 (CAAA). Presently, there are 189 HAPs.

Test Report Section 1 Revision 1 June 2002 Page 5 of 5

As part of the broader engine-testing program, the USAF, through the Human Systems Center (HSC) (now AFIERA/RSEQ) at Brooks Air Force Base, TX, has contracted to have the emissions characterized from the F119-PW-100 engine operating at a variety of settings utilizing JP-8 fuel. Testing of the F119-PW-100 engine conducted during the week of September 11, 2000 at the Lockheed Martin Aeronautical Systems Facility is the focus of the sampling effort described within this document.

1.4.1 F119-PW-100

Two F119-PW-100 turbofan engines power the F-22 Raptor aircraft. Pratt & Whitney manufactures these engines at its Florida Operations Center. The maximum thrust of the engine is in the 35,000 pound class; however, the engine is experimental and no other data was available prior to the sampling program.

1.4.2 Test Facility

The F119-PW-100 engine was sampled at the Lockheed Martin Aeronautical Systems (LMAS) facility located in Marietta, Georgia. The LMAS Facility is a contractor facility which develops, manufactures, and tests a variety of military and rocket engines. Testing was conducted within a facility hush house.

Test Report Section 2 Revision 1 June 2002 Page 1 of 17

SECTION 2

FACILITY AND SAMPLING APPARATUS DESCRIPTION

As stated in Section 1, testing of the F119-PW-100 engine was performed at the Lockheed Martin Aeronautical Systems (LMAS) facility utilizing JP-8 jet fuel. Due to the physical layout of the LMAS hush house testing location, the engine exhaust could not be sampled safely or cost-effectively using traditional EPA-recommended emission testing methodologies. In addition, the traditional International Civil Aviation Organization (ICAO) sampling method does not address particulate or HAP analysis. A description of the hush house, sampling system apparatus, and general sampling methodology is provided in this section. A more detailed description of the sampling methodology is provided in Sections 3 and 4.

2.1 LOCKHEED MARTIN AERONAUTICAL SYSTEMS (LMAS) TEST FACILITY OVERVIEW

Military aircraft jet turbine engines are tested in indoor enclosures designed to restrain the engine or aircraft and to provide suitable environmental protection while testing occurs. These facilities are also known as hush houses. The building functions include supply air filtration, noise suppression, exhaust diversion, and technical support for various test functions. The layout of a typical hush house interior and exterior are illustrated in Figures 2-1and 2-2. During the test process, aircraft or isolated engines are mounted in the rear of the hangar-like enclosure with the exhaust nozzle pointing toward the augmentor tube and out of the building (Figure 2-3). The engine exhaust is directed out of the test facility and into the ambient air via a horizontal elliptical duct (the augmentor tube) which finally directs the air flow upward via a terminal deflector plate in

Test Report Section 2 Revision 1 June 2002 Page 2 of 17

the blast box (Figure 2-4). The hush house emits combustion products mixed with filtered dilution air directly to the atmosphere at the augmentor tube terminus.

For this test program, the test team collected samples directly behind the engine exhaust nozzle at two engine settings and prior to the exit of the hush house augmentor tube, near the point of entry into the blast box at all engine settings.

2.2 ENGINE EXHAUST SAMPLING RAKE SYSTEM

As part of the test program at LMAS, gaseous emissions directly behind the engine were measured at timed intervals in a similar manner described by ICAO at the idle and approach engine settings. Engine exhaust sampling was conducted using a cruciform rake mounted approximately 2.5 feet downstream from the exhaust. The intent of the ICAO mounting location parameters were considered for rake placement. A schematic diagram of the rake assembly is illustrated in Figure 2-5. This system was utilized during a previous test program and was obtained by AFIERA for use during this portion of the engine study. The rake contains 12 ports spaced across four rake arms, each of which contains a 1/8-inch orifice. A mixed exhaust sample was drawn from the 12 ports and transferred via a single stainless steel tube through filtered and heated Teflon® lines to the combustion and diluent gas conditioning system and analyzers. The photograph in Figure 2-6 shows the rake assembly mounted behind the F119-PW-100 engine. The rake was installed behind the engine during the idle and approach phases of the testing program. The rake was removed during the remaining engine settings in order to eliminate the potential for engine or hush house damage.

2.3 AUGMENTOR TUBE SLIPSTREAM SAMPLING SYSTEM

Access to the area of emissions exhaust is restricted during operation of engines in the hush house due to safety concerns including high temperatures, high velocity and vibration, excessive noise, and the potential of exposure to the exhaust gases. It was therefore necessary to devise a sampling scheme that allows sampling to be conducted

Test Report Section 2 Revision 1 June 2002 Page 3 of 17

from a remote location that required modification to existing point source EPA emission test procedures.

The slipstream sampling system shown in Figures 2-7, 2-8 and 2-9 was constructed to measure jet engine emissions from the Langley AFB hush house as part of the F100-PW-100 jet engine emission tests conducted in November 1996. Similarities between that testing program and the current sampling effort allowed the sampling system to be applied to the F119-PW-100 engine sampling program completed at the LMAS facility hush house. The system was designed to extract an augmentor tube exhaust sample and to permit use of standard source emission test methods that could not be applied immediately behind the test engine or in the augmentor tube.

A stainless steel pipe, 10 inches in diameter, was utilized to extract a side-stream sample of the diluted engine emissions at a point upstream of the augmentor tube exit. The duct was centered in the augmentor tube and extended approximately 10 feet into the augmentor tube. The duct was supported inside the augmentor tube by two sets of support stands. The duct was directed horizontally toward the rear of the blast box and then turned at an angle out of the blast box to the top of the deflector shield wall, where a transition to a 24 inch by 24 inch square duct occurred. The duct was constructed of stainless steel seamless pipe with flanged ends. Each section was bolted together at the flanged end. Each piece was 10 feet in length except for the inlet and elbows. Any welds in the duct system were factory welds. The larger square duct provided a decrease in gas velocity and a suitable sampling location for applying standard emission testing methods. The inlet to the slipstream was circular, similar to the inlet of a large Method 5 sampling nozzle. At the end of the square duct was a deflector plate to vent emissions upward away from ground activities (See Figures 2-10, 2-11 and 2-12).

The stainless steel slipstream ductwork was supported inside the augmentor tube by attaching pipe risers to existing bolts in the U-channels inside the augmentor tube. Two radial stands were used inside the augmentor tube.

Test Report Section 2 Revision 1 June 2002 Page 4 of 17

Attachments were made to the 10-inch pipe with 10-inch pipe collars and bolts. All bolts were secured with a washer, lock washer, and a nut. Bulkhead fittings were used to provide sampling ports through the C-Channel in the first support brace. The same inlets were constructed of four pieces of 1/4 inch C-Channel extending from the duct radially outward (at 90⁰ angles) to the wall of the augmentor tube to create the slipstream rake. Sampling lines and thermocouples were directed through an iron pipe conduit to the exit. The conduit was secured to the supporting braces via bolts and Uclamps. The duct was then fastened to the blast box and supporting scaffolding outside the blast box. This approach provided structural integrity, reduced the cross sectional exposure profile of freestanding duct, and subjected the duct only to radial flow forces on the plate, or turbulent forces along the entire exposed length. Twelve sampling points were used for gaseous sampling inside the augmentor tube. Scaffolding fixed to the hush house and ground supported the rectangular ductwork outside the hush house. Scaffolding was secured to each other and to 1/2-inch-thick plywood on the ground to provide further vibration support.

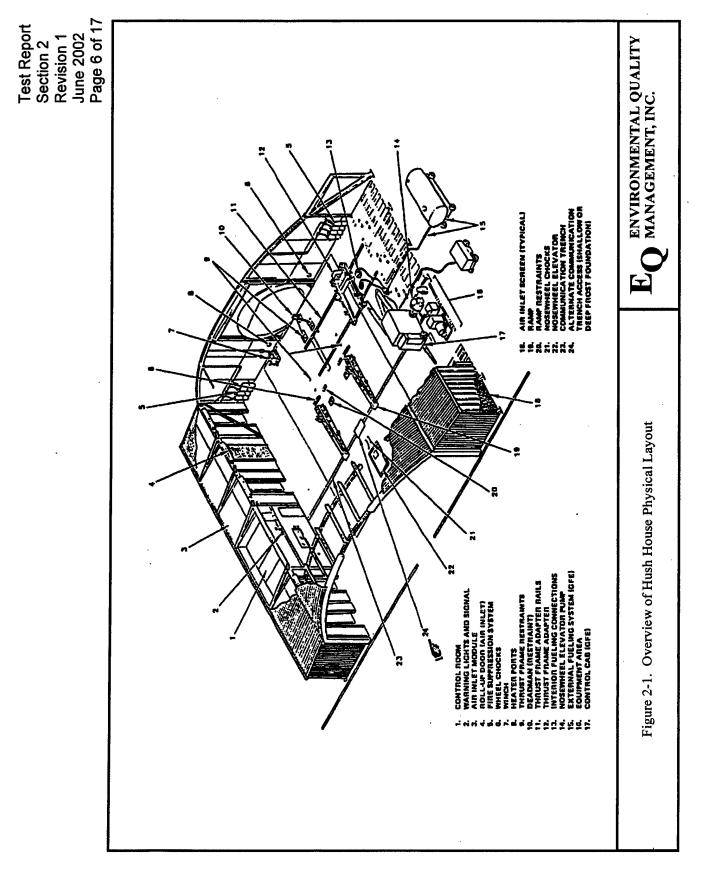
This sample collection structure provided full use of the hush house for purposes other than emission testing. Once the sampling structure was installed, the hush house was available for testing of other engines as needed. The structure did not interfere with the normal operation of the hush house.

Engine exhaust samples were collected at multiple locations along the slipstream. Gaseous emission (CO, $NO_x CO_2$ and VOC) samples were collected at the slipstream rake from 12 sample ports installed in the brace. Particulate and HAP emission samples were collected from sample ports in the slipstream duct outside of the hush house.

The locations of the sampling points for the slipstream sampling rake were positioned using EPA Method 1 criterion. Since the duct was oval shaped and EPA Method 1 does not accommodate this configuration, the points were determined across the major axis assuming a circular diameter. Similarly, the points across the minor axis

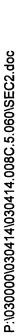
Test Report Section 2 Revision 1 June 2002 Page 5 of 17

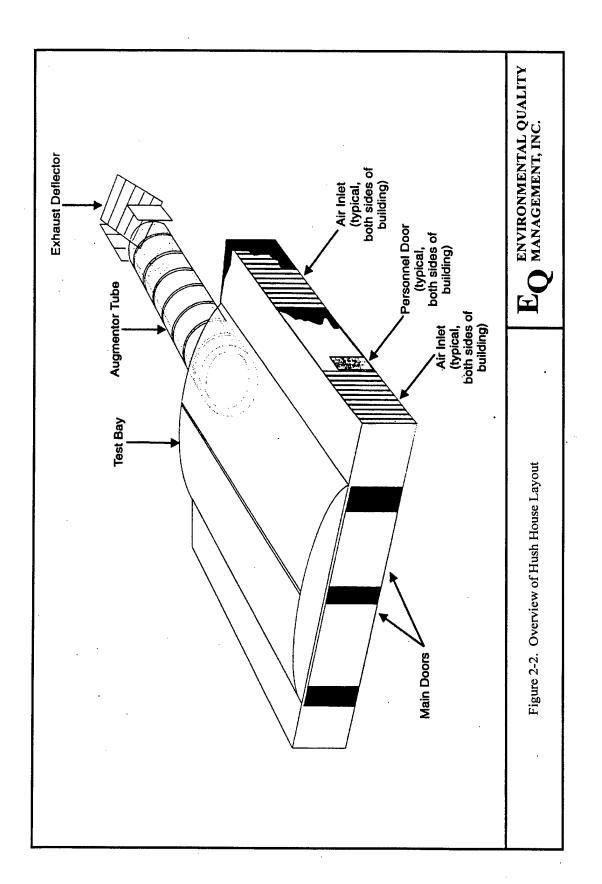
were calculated assuming a circular diameter. The slipstream duct was positioned in the center of the augmentor tube. Although the oval cross sectional shape of the augmentor tube is not addressed in EPA Method 1, locating the sampling point inlet at least 1/2 duct diameter prior to the exit of the tube was consistent with the basic tenets of EPA Method 1. Samples of the augmentor tube exhaust were obtained for combustion and diluent gas analysis using the slipstream rake assembly mounted in the augmentor tube.



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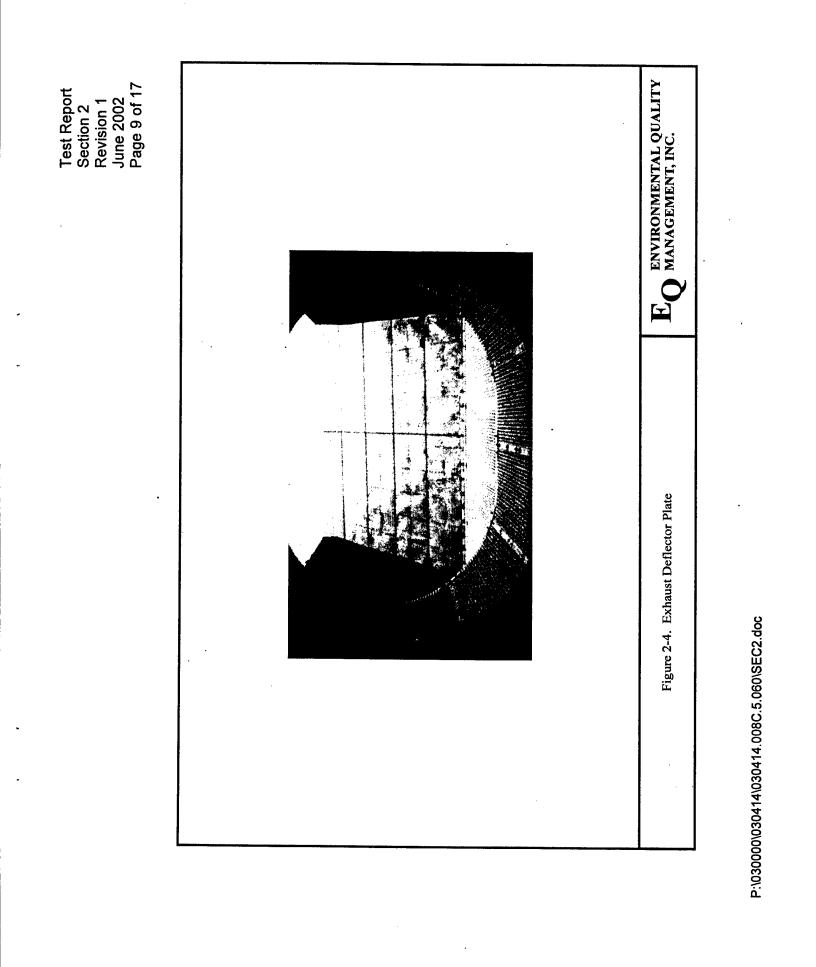
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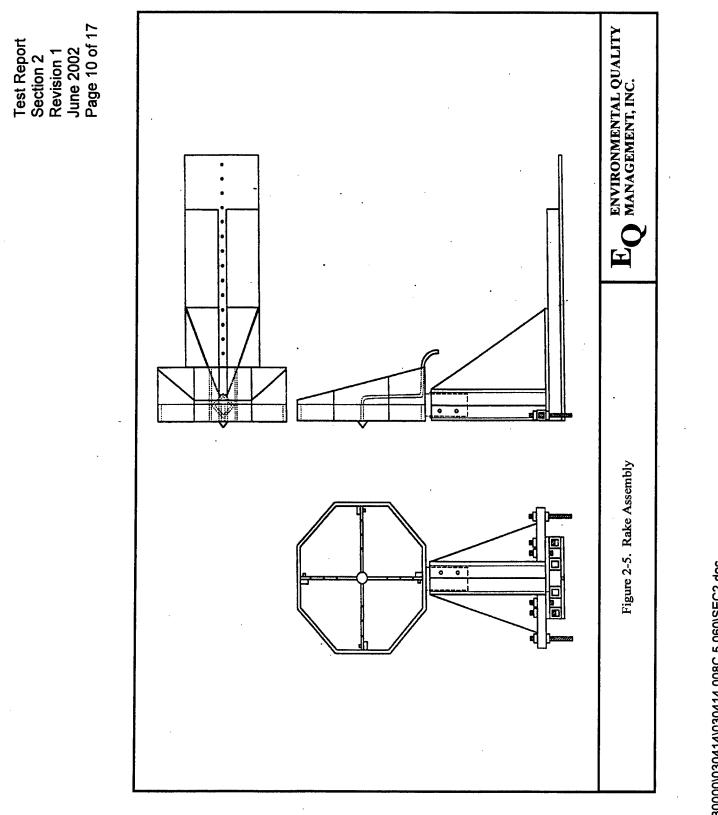


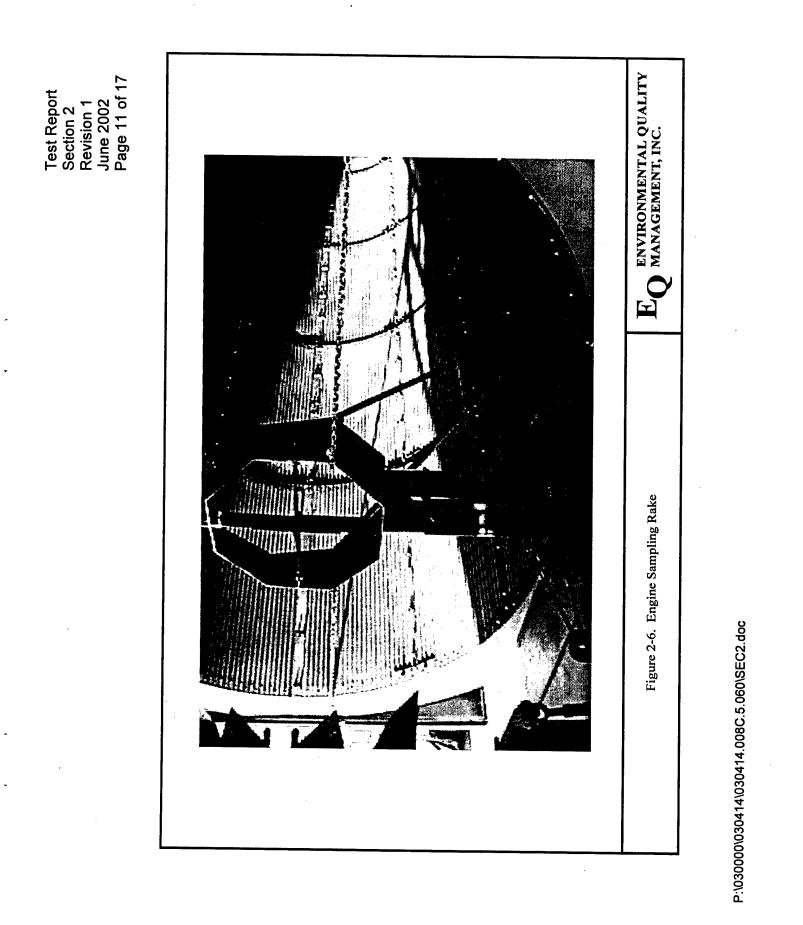


Test Report Section 2 Revision 1 June 2002 Page 7 of 17 Test Report Section 2 Revision 1 June 2002 Page 8 of 17 ENVIRONMENTAL QUALITY MANAGEMENT, INC. E Figure 2-3. Engine Mounted for Testing in Hush House

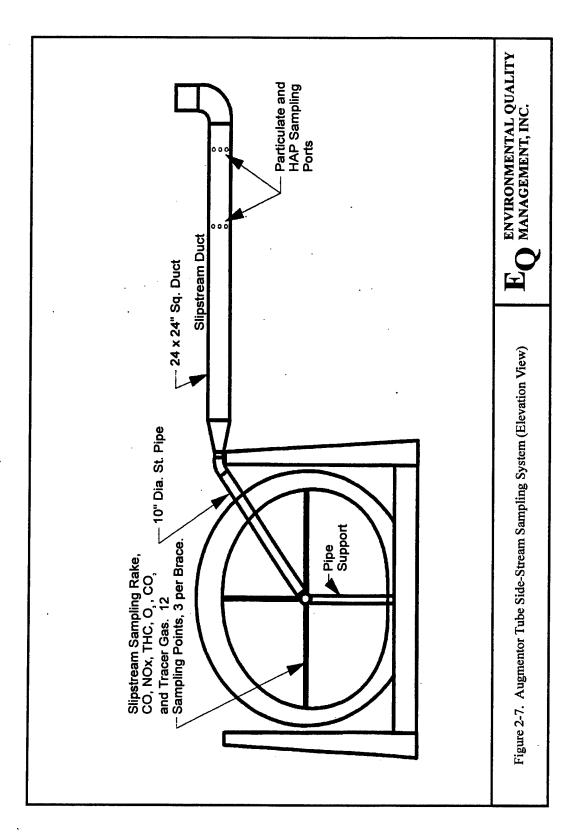
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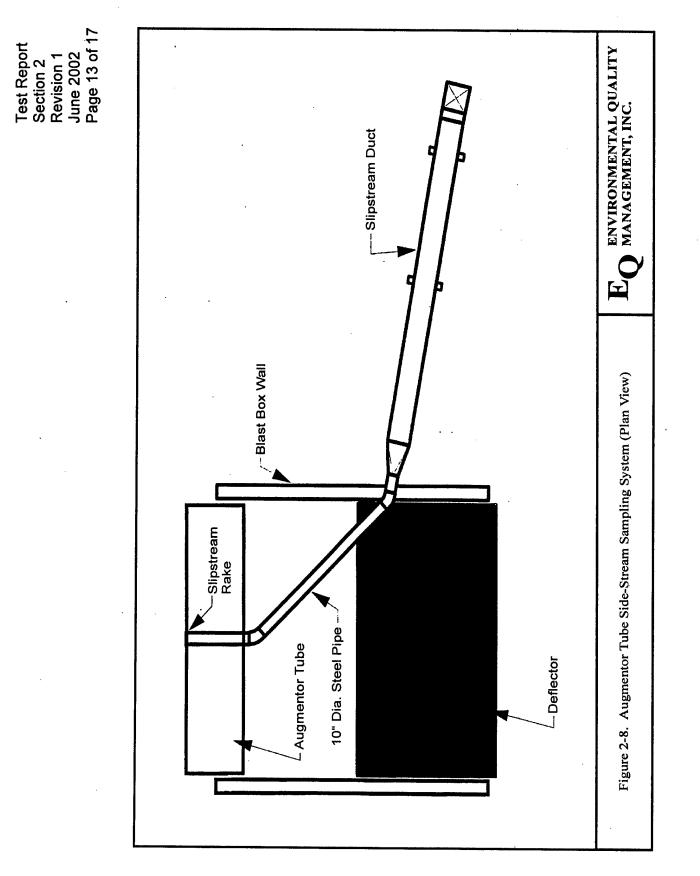




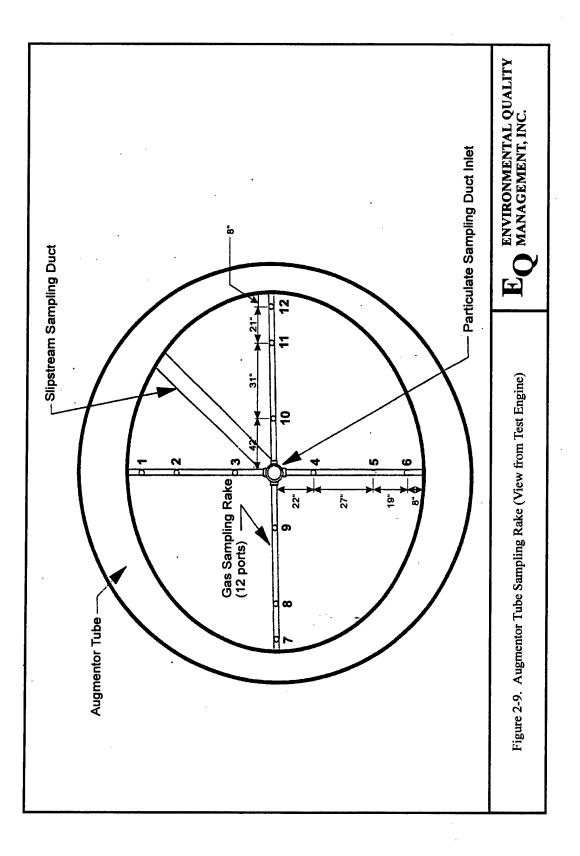


Test Report Section 2 Revision 1 June 2002 Page 12 of 17

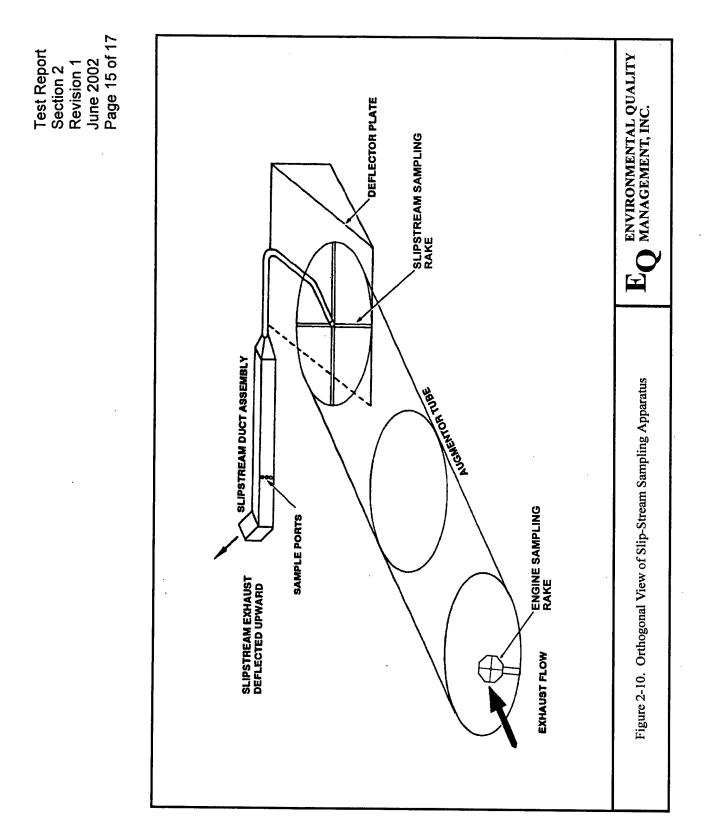




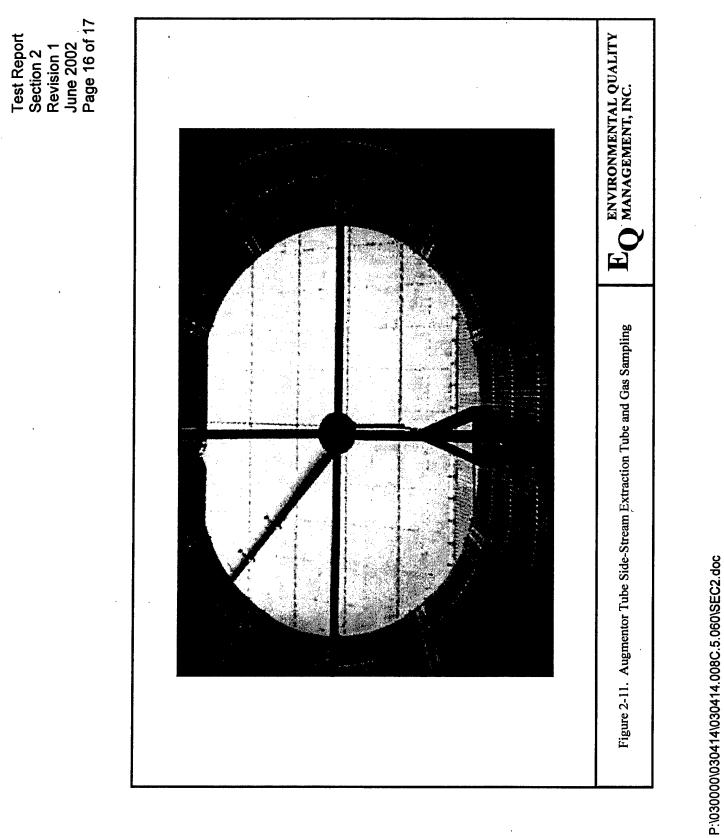
Test Report Section 2 Revision 1 June 2002 Page 14 of 17



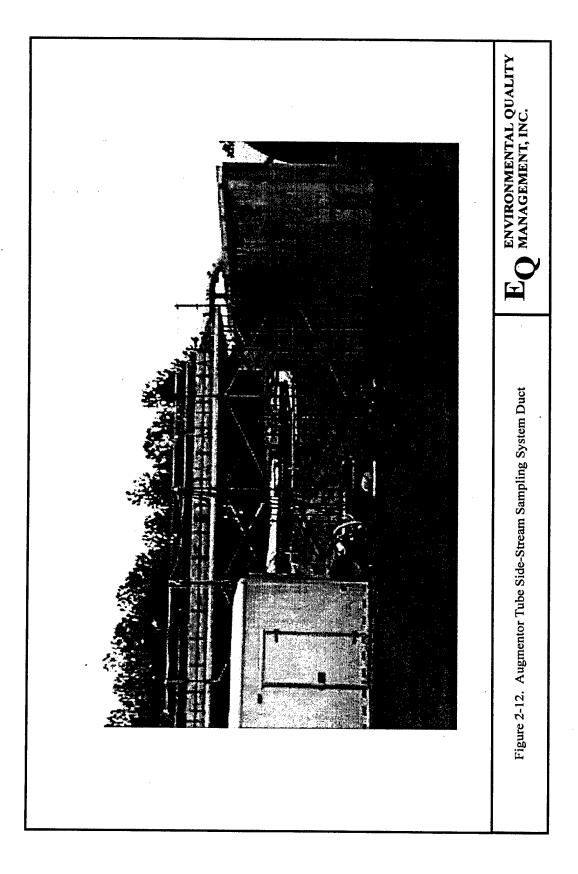
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Test Report Section 3 Revision 1 June 2002 Page 1 of 22

SECTION 3

SAMPLING PROCEDURES AND METHODS

The testing program involved sample collection at three locations: 1) directly behind the engine (gaseous emissions, benzene and formaldehyde), 2) at the hush house augmentor tube exit (particulate and HAP), and 3) at the intake to the slipstream inside the augmentor tube (gaseous emissions). The purpose of the multiple sample locations was to note the variance (if any) in gaseous emissions (CO, NO_x, VOC) inside the hush house augmentor tube and to look at pollutant dilution and secondary pollutant formation by sampling directly behind the engine. (During the idle and approach slipstream sample runs, an approximate 30-minute sample was collected from the engine sampling rake). The focus of the program was to verify engine emissions from the hush house.

The determination of emissions from the engine test stand through the hush house augmentor tube presented a unique challenge to accurately measure emission rates of the target pollutants. A number of constraints and unknown parameters were present sampling this engine that are not associated with a more traditional emissions testing programs. These variables were difficult to account for because of the inability to measure outlet flow parameters. The flow parameters included flow rates, temperature, and dilution of ambient air in the exhaust gas stream. The program was designed to allow for those variables so that representative data could be collected in a timely and cost-effective manner.

3.1 GENERAL SAMPLING CONSIDERATIONS/COMPLICATIONS

Access to the area of emissions exhaust was restricted during operation of engines in the hush house due to safety concerns including high temperatures, high velocity

Test Report Section 3 Revision 1 June 2002 Page 2 of 22

and vibration, excessive noise, and the potential of exposure to the exhaust gases. It was therefore necessary to devise a sampling scheme, which allowed sampling to be conducted from a remote location, which required some modification to existing test procedures. The slipstream sampling approach allowed particulate matter and HAP testing personnel to be located outside the exclusion zone.

The physical structure of the exhaust through the augmentor tube did not allow for use of the traditional isokinetic sampling methodologies. Complicating factors included large amounts of dilution air and limited testing windows. Based on these considerations, several assumptions were made to address the unique nature of this program. Assumptions included homogeneous mixing of the exhaust stream (verification of this assumption was made in the field); theoretical methods for determining air flow through the system; and particulate distribution behavior equivalent to gaseous. These assumptions were based on previous engine testing programs and reference documents.

3.1.1 Pollutant Distribution in the Augmentor Tube

The test program was based on the assumption that, as the exhaust gas exits the test stand through the augmentor tube, the exhaust stream from the engine and the dilution air have reached a homogeneous mixture. This assumption had been validated in testing conducted by EQ at Edwards AFB (EQ Report, *Source Sampling and Testing of Aerospace Equipment and Jet Engines at Edwards AFB, CA*) and by Radian Corporation at Langley and Cannon Air Force Bases (presentation by Captain Gregory Durand, USAF at the 89th Annual Meeting and Exhibition of the Air and Waste Management Association, *Emission Factors for JP-8 Combustion Sources*). The gas stream was found to be homogeneous in the hush house augmentor tube at approximately 60 feet behind the jet engine exhaust point. The complete mixing of exhaust gases and the dilution air are the result of the very turbulent flow from the jet engine exhaust. This is discussed further in Section 6.

Test Report Section 3 Revision 1 June 2002 Page 3 of 22

Particulate size distribution in the engine exhaust was shown to be significantly less than 10 microns (µm) in size (Characterization of Chemicals on Engine Exhaust Particles: F101 and F110 Engines, ESL-TR-89-20, Air Force Engineering and Services Center Engineering and Services Laboratory and Source Sampling and Testing of Aerospace Equipment and Jet Engines - Test Protocol - Edwards AFB, CA, EQ December 1995). Typically, and in the case of this test program, the majority of particles are less than 2.5 µm. Because of the size of the particles, it was assumed that they would behave as an aerosol or gas and that pollutants would be distributed evenly throughout the test stand exhaust. The basis for this assumption was also discussed in the reference Air Pollution, Its Origin and Control by K. Wark and C. Warner, published by Harper & Row Publishers, 1981. Since it was assumed that all particulate (and those contaminants bound to the particulate) would behave as an aerosol, the stack or any point in the stack would have the same concentration of pollutants. This assumption was used as the basis to conduct single-point isokinetic sampling at one point in the exhaust, which was representative of all points in this engine test exhaust. This was justified during the test program and is presented in Section 6.4.

Because it was assumed, and had been documented, that the majority of the particulate was less than 10 μ m, EPA Method 5 was used. The particulate filters were analyzed by a scanning electron microscope (SEM) to confirm the particle morphology and size distribution. The distribution was based on the particle count in each size range. In addition, an experimental real time sampler was utilized to collect particulate matter samples. Sampling methodologies for particulate are discussed in Section 3.2.4-1. A cascade impactor was considered to determine the particle size distribution by mass. Due to the expected low particulate concentrations, the impactor would not be effective in collecting a quantitative sample. Also, the size range of each stage of the impactor is larger

than the expected particle diameter; therefore, all particles would be collected on the final stage.

Test Report Section 3 Revision 1 June 2002 Page 4 of 22

Although it was assumed that pollutant concentrations in the augmentor tube would be homogeneous, this assumption was verified by the use of tracer gas. The tracer gas, sulfur hexafluoride (SF₆), was dispersed from multiple points outside the hush house into the engine exhaust gas stream as it entered the augmentor tube and was measured near the outlet at multiple points on the slipstream support brace. Based on the turbulent flow of the exhaust and the passage of the exhaust gases through the silencer, the SF₆ was dispersed equally in the exhaust. A random number of the 12 sample points from the slipstream cross brace were sampled at various engine settings to verify that the tracer gas was dispersed equally. Further discussion of tracer gas methodology is included in Section 4.1 of this document.

3.2 EMISSION TESTING

Sampling was performed for criteria pollutants and those HAPs that are products of incomplete combustion (PICs). The following compounds were monitored from the slipstream system sampling:

- Filterable and condensable particulate (EPA Methods 5 and 202).
- Aldehydes and ketones (EPA Method 0011).
- Volatile organic compounds (VOCs) (EPA Method 0030), including 1,3 Butadiene.
- Oxygen and carbon dioxide (EPA Method 3A).
- Carbon monoxide (EPA Method 10).
- Nitrogen oxides (EPA Method 7E).
- Total hydrocarbons (THCs) (EPA Method 25A).
- Methane (EPA Method 25A).
- Total particulate matter (Continuous monitor, experimental method).

The following compounds were monitored from the engine rake:

- Oxygen and carbon dioxide (EPA Method 3A).
- Carbon monoxide (EPA Method 10).
- Nitrogen oxides (EPA Method 7E).
- Total hydrocarbons (THCs) (EPA Method 25A).
- Methane (EPA Method 25A).
- Benzene and formaldehyde

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Test Report Section 3 Revision 1 June 2002 Page 5 of 22

The engine exhaust system was not sampled for sulfur dioxide, metals or semivolatiles. Sulfur dioxide emissions were reported based on the procedure documented by AESO. This procedure estimates that sulfur dioxide emissions can be estimated by assuming all sulfur in the fuel undergoes complete oxidation to SO₂. The sulfur content in JP-8 fuel was determined during testing to assure consistency with published results. The emission factor for SO₂ is provided in this report. Concentrations of the following metals were not detected in the fuel analysis: antimony, arsenic, barium, beryllium, cadmium, cobalt, chromium, lead, manganese, mercury, nickel, selenium, silver and thallium. Dioxins, furans, semi-volatiles and HAPs not discussed in the subsequent text were not a target of this program and had the potential to be emitted in quantities too small to be detected by the sampling methods described in this program.

Grab samples were collected behind the engine at the engine rake to determine the concentration of benzene and formaldehyde. This was performed at the idle and approach engine settings to compare to the data collected at the slipstream.

The unique feature in conducting emissions testing for this engine was that the exhaust stream at the hush house exhaust was significantly diluted with ambient air. This presented three problems: (1) the volume of exhaust gas was significantly increased; (2) dilution of the exhaust may have made it difficult to detect various pollutants; and (3) the ambient air concentration of various pollutants may have been detectable by emissions test methods. These problems may have biased the engine exhaust emissions estimates on the high side. The volume of gas at the augmentor tube exhaust was not measured directly, but was calculated indirectly through a tracer gas and calculated by F-factor and carbon balance. Because of significant dilution with the ambient air, some compounds needed to be sampled for and composited over three runs to provide adequate sample volume to reach analytical detection limits. The background ambient air concentrations were variable and could significantly bias results since ambient concentrations may have been higher than the detection limit of the source sampling methods.

Test Report Section 3 Revision 1 June 2002 Page 6 of 22

Ambient air sampling was conducted in conjunction with emissions testing to quantify and qualify background emissions concentrations. Ambient samples were collected at the air intakes for the following compounds:

- Particulate TSP (40 CFR, Part 60, Appendix B).
- VOCs (EPA Method TO-14).
- CO (EPA Method 10)
- NO_X (EPA Method 7E)
- CO₂ (EPA Method 3A)

It was not known which compounds would have been detected using the methods proposed because this level of testing for HAPs had not been documented on aircraft engine emissions. Based on the results for the first 17 engines, the program was modified by reducing the target number of HAPs collected (ambient and source). The target pollutant list was reduced based upon the lack of detection of semi-volatile HAPs. Ambient data for aldehydes and ketones was not consistent during past sampling efforts and therefore was removed from the target list.

3.2.1 Flow Rate Measurement

As stated previously, standard flow rate measurements could be performed at this test location. Additionally, there was a limited test window in which the inlet flow measurements could be taken. The identification of inlet flow rates was critical to determining the ambient contribution of pollutants in the inlet air. Outlet flow from the augmentor tube was determined by an indirect method (tracer gas) and theoretical methods (carbon balance and F-factors). Regardless of the SF₆ injection temperature, discussed in Section 4, the use of multiple-flow measurement/calculation methods was intended to provide a firm basis for identifying and rejecting outlier data. The flow data collected by any one method at a given condition, as well as the flow data collected by all methods for the engine at different operating conditions. An established relationship was expected between engine operating level and total flow. All flow measurement methods provided valid data at one or more operating conditions. The

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Test Report Section 3 Revision 1 June 2002 Page 7 of 22

data evaluation identified which measurement deviated from that relationship, and whether that deviation could be attributed to a physical parameter such as temperature, oxygen concentration, etc. If the deviation was predicted (e.g., high oxygen concentration impact on F-factor calculation), that data was discarded. If there was no obvious physical explanation, best-fit estimates at other loads were used to identify and reject the outlier.

Inlet concentrations for some compounds were measured as part of the theoretical flow determination method using carbon balance and F-factors. At the inlet location, THC was measured using a hydrocarbon analyzer identical to the one that measured engine exhaust gas THC. An inlet carbon dioxide (CO_2) measurement was also required as input to the theoretical flow model. An ambient CO_2 monitor was used to measure the inlet CO_2 concentration during each test run.

Section 4 discusses in detail the methodologies that were applied to calculate air flow at the LMAS engine test facility.

3.2.2 Pretest Measurements

Preliminary test data were obtained at the slipstream during the shakedown runs. Preliminary flow rate data and gas composition data were collected. Augmentor tube and slipstream sampling geometry measurements were obtained and recorded, and sampling point distances verified. A preliminary velocity traverse was performed in the slipstream utilizing a calibrated S-type pitot tube and a Dwyer inclined manometer to determine velocity profiles. Exhaust gas temperatures were observed with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple. Water vapor content was measured using EPA Method 4.

A check for the presence or absence of cyclonic flow was conducted in the slipstream. Preliminary test data were used for nozzle sizing and sampling rate determinations. Probe nozzles, pitot tubes, metering systems, and temperature measurement devices were calibrated on site as specified in Section 5 of EPA Method 5 test procedures.

Test Report Section 3 Revision 1 June 2002 Page 8 of 22

3.2.3 Emissions Test Methods

The following paragraphs discuss methods that were utilized for emissions testing. Furthermore, Appendix B of this document presents the emissions sampling methods in greater detail, including descriptions of exhaust emissions test sampling trains, sample preparation, sample procedures, sample recovery, and analytical procedures.

<u>Particulate Sampling</u> - EPA Method 5 was used for particulate sampling at the slipstream exhaust. The sampling train utilized to perform particulate sampling conformed to EPA Reference Methods 5 and 202 for the collection of both filterable particulate and back-half condensable particulate. Select particulate samples were submitted for analysis of particle size distribution and shape. The particulate was analyzed using a scanning electron microscope (SEM) equipped with an IXRF iridium digital image system. Due to the low concentration of particulate matter in the exhaust, several sampling procedure comments were received from SPAWAR SYSCEN D3621. EQ incorporated the following suggestions:

- 47 mm diameter filters will be used
- The humidity in the weighing room will be less than 50%
- A balance accurate to 5 decimal places will be used.

<u>Real Time Particulate Mass Determination</u> - In addition to EPA Methods 5 and 202, an attempt was made to utilize an experimental TEOM[®] Series 7000 Source Particulate Monitor to collect real-time total particulate matter samples. However, the sampler could not withstand the vibrations on the test stand created by the engine thrust. Therefore, data collected by the sampler was limited and could be utilized only for particle size analysis. A more detailed description of the sampling apparatus and methodology is found in Appendix B.

Test Report Section 3 Revision 1 June 2002 Page 9 of 22

<u>Aldehyde and Ketone</u> - The sampling train utilized to perform aldehyde and ketone sampling conformed to BIF Method 0011.

<u>VOCs</u> - The sampling train utilized to perform VOC sampling conformed to EPA Reference Method 0030. Table 3-1 lists the VOCs that were analyzed for in each sample.

N	VOST Compounds – Clean Air Act List
Acetone Benzene Bromodichloromethane Bromomethane Bromoform 2-Butanone 1,3 Butadiene Carbon disulfide Carbon disulfide Carbon tetrachloride Chlorobenzene Chlorodibromomethane Chlorodibromomethane Chloroform Chloromethane 1,1-Dichloroethane 1,2-Dichloroethane	Air Act List Trans-1,2-Dichloroethene 1,2-Dichlorophropane Cis-1,3-Dichloropropene Trans-1,3-Dichloropropene Ethylbenzene 2-Hexanone Methylene chloride 4-Methyl-2-pentanone Styrene 1,1,2,2-Tetrachloroethane Tetrachloroethene Toluene 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethene Trichloroethene Trichloroethene

TABLE 3-1. SUMMARY OF SOURCE TARGET COMPOUNDS FOR VOLATILE ORGANIC COMPOUNDS

<u>Gaseous Pollutants</u> – EPA methods 7E and 10 were utilized to determine the concentration and mass emission rate of NO_x and CO, respectively.

Test Report Section 3 Revision 1 June 2002 Page 10 of 22

<u>Methane and Non-methane Hydrocarbons (NMHC)</u> – NMHCs were measured directly using a JUM Model 109A methane/non-methane hydrocarbon analyzer. The Model 109A contains two flame ionization detectors (FIDs). The sample is split before being sent to the respective FIDs. One fraction is passed through a catalytic converter to combust all non-methane hydrocarbons (to CO_2) before the sample is measured in the FID. The methane residual in the sample is the only component that is measured by that detector. The other sample fraction is sent to the second FID, which measures the total hydrocarbon concentration of the sample. Both FIDs are initially calibrated with a methane calibration standard, so both the total hydrocarbon and the methane residual are measured as methane. The difference between these two values is automatically determined and reported as non-methane hydrocarbons by the Model 109A.

The THC analyzer was challenged with a zero and span gas at the beginning and end of each sample day to calibrate and assess the instrument's calibration.

<u>Metals</u> - Emissions sampling was not completed for metal exhaust emissions. Fuel analysis for JP-8 was performed to determine the concentration of various metals in JP-8 fuel. The analytical procedure involved the combustion of JP-8 fuel in an evaporative dish. The combustion residue was ashed in a muffle furnace. Ash product was treated with an aqua regia to digest any residual carbon. The solution was diluted then analyzed via Inductively Coupled Plasma Spectroscopy, Cold Vapor Atomic Absorption Spectroscopy (Hg), or treated with chelating agent and analyzed via colorimetric methodology (P). Concentrations were determined for the metals listed in Table 3-2.

Test Report Section 3 Revision 1 June 2002 Page 11 of 22

	ROM JP-8 FUEL ANALYSIS
Antimony	Arsenic
Barium	Beryllium
Cadmium	Cobalt
Chromium	Copper
Lead	Manganese
Mercury	Nickel
Phosphorus	Selenium
Silver	Thallium
Zinc	

TABLE 3-2. SUMMARY OF SOURCE TARGET METALS FROM JP-8 FUEL ANALYSIS

3.2.4 Ambient Air Sampling

Due to the high ambient air dilution rate for the engine tests, background levels of gaseous pollutants were taken into account in determining the emissions from the hush house. For example, fuel handling operations in the area could have contributed to background hydrocarbons. Similarly, CO and/or NO_x levels could have been affected by vehicles, heavy machinery operating in the area, or aircraft emissions. The carbon balance methodology used for flow rate determination required ambient samples to be collected as part of the normal testing. A sample was collected from one side of the hush house near the air intake.

The ambient air sampling program was designed to collect air samples to be analyzed for pollutants in the following two major categories:

- Gases
- Particulates

Ambient air sampling, equipment operations, and calibration followed standard operating procedures (SOPs) for each method. Ambient air sampling was performed in conjunction with all emissions testing. Ambient air sampling commenced at the start of each emissions test run and was concluded at the completion of the final emissions test run. The ambient air samples were composited over the three 1-hour test runs for each engine power setting. Samplers were turned on and off manually. These results were used to correct for any bias introduced by pollutants found in the ambient air.

Test Report Section 3 Revision 1 June 2002 Page 12 of 22

The following subsections present brief descriptions of the ambient air sampling and analytical methods used for each of the pollutants or pollutant groups. The descriptions include overviews of the sampling equipment, collection media, and analytical techniques used for each pollutant or pollutant group.

3.2.4.1 Particulates

Particulate matter (total suspended particulates) was sampled using General Metal Works high-volume (Hi-Vol) air samplers with volumetric flow controllers. The particulate sampling program was operated according to EPA guidelines as described in the *Quality Assurance Requirements for Prevention of Significant Deterioration*, 40 CFR, Part 50, Appendix B. Sample filters were analyzed by a gravimetric method using pre- and postweights to determine total particulates. During each 1-hour sample run, 68 m³ of sample were collected. For the composite 3-hour sample, a total of 204 m³ of volume was sampled. With an analytical detection limit of 0.1 milligram (mg), the method detection was $0.5 \mu \text{g/m}^3$.

3.2.4.2 Volatile Organic Compounds

Volatile organics were sampled using passivated stainless-steel Summa[®] canisters, which were analyzed by gas chromatography/mass spectrometry (GC/MS) per EPA Method TO-14.

A Summa[®] canister is a stainless-steel vessel that has had its internal surfaces specially passivated using a "Summa" process. This process combines an electropolishing step with chemical inert. A Summa surface has the appearance of a bright and shiny mirror. A sample enters the canister through a high-temperature, stainless-steel bellows valve. A Summa canister will hold a high vacuum (<1 m Torr: <28 inches Hg) for up to 30 days. After 30 days, it is necessary to evacuate the canister prior to use to ensure that it is free of contaminants.

Canisters are cleaned using a combination of exponential dilution, heat, and high vacuum. They are generally batch-certified (1 in 10) by filling them with ultra-high-purity

Test Report Section 3 Revision 1 June 2002 Page 13 of 22

air, which is subsequently analyzed using either GC/MS (TO-14) or GC/ flame ionization detection (FID) (TO-12). If the target analyte concentrations are below 0.2 part per billion by volume (ppbv) (TO-14) or if the total hydrocarbon level is less than 0.2 ppbv, the batch of canisters is considered "clean" and is certified for use.

Although 14 days is the most commonly cited holding time for a canister sample, the holding time is somewhat analyte-specific. For example, nonpolar analytes such as chloroform, benzene, and vinyl chloride are stable in a canister for at least 30 days. However, polar analytes such as methanol and acetone often will condense on the canister walls (the degree of which is a function of the sample humidity). Analysis of these samples should be performed within 72 hours.

The passivated canister sampling used pre-set flow controller devices to regulate the sampling flow rate into the canister. The flow controllers allowed an integrated sample to be collected without the canister achieving an equilibrium ambient pressure. Sampling was conducted using an evacuated 6 liter Summa canister. The flow into the canister was controlled by an orifice to allow approximately 1.5 liters of sample to be collected during each 1-hour sample run for a total of 4.5 liters per three runs.

Table 3-3 lists the VOCs that were analyzed for in each sample.

3.2.4.3 Carbon Monoxide and Nitrogen Oxides

Sampling was performed using a continuous emissions monitoring system (CEM) for oxygen and carbon dioxide (EPA Method 3A), carbon monoxide (EPA Method 10), and nitrogen oxides (EPA Method 7E). Due to the expected low concentration of CO_2 in the exhaust stream at the slipsteam, an ambient CO_2 monitor was used at the exhaust. The ambient analyzer had the ability to measure the concentration in several ranges: 0-1,000 ppm, 0-1% and 0-5% CO_2 .

Test Report Section 3 Revision 1 June 2002 Page 14 of 22

TABLE 3-3. SUMMARY OF AMBIENT TARGET COMPOUNDS FOR VOLATILE ORGANIC COMPOUNDS

Volatile Organic Com	pounds – EPA Method TO-14 List
Freon 12	m,p-Xylene
Freon 114	o-Xylene
Chloromethane	Styrene
Vinyl Chloride	1,1,2,2-Tetrachloroethane
Bromomethane	1,3,5-Trimethylbenzene
Chloroethane	1,2,4-Trimethylbenzene
Freon 11	1,3-Dichlorobenzene
1,1-Dichloroethene	1,4-Dichlorobenzene
Freon 113	Chlorotoluene
Methylene Chloride	1,2-Dichlorobenzene
1,1-Dichloroethane	1,2,4-Trichlorobenzene
cis-1,2-Dichloroethene	Hexachlorobutadiene
Chloroform	Methanol
1,1,1-Trichloroethane	Ethanol
Carbon Tetrachloride	Isopropanol
Benzene	Acrolein
1,2-Dichloroethane	Acetone
Trichloroethene	Acetonitrile
1,2-Dichloropropane	Acrylonitrile
cis-1,3-Dichloropropene	Vinyl Acetate
Toluene	Tetrahydrofuran
trans-1,3-Dichloropropene	1,4-Dioxane
1,1,2-Trichloroethane	Ethyl Acetate
Tetrachloroethene	2-Butanone
Ethylene Dibromide	Methyl Methacrylate
Chlorobenzene	4-Methyl-2-Pentanone
Ethyl Benzene	

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Test Report Section 3 Revision 1 June 2002 Page 15 of 22

3.3 ENGINE TEST CYCLE DATA

In order to correlate the aircraft engine emissions data with the engine operation, facility personnel compiled selected engine test cycle data during testing. The engine test monitoring system at this test stand constantly monitored a variety of engine parameters during engine testing. For the purpose of emissions sampling, a select number of these parameters were provided to the SPO for emission factor development. These parameters assisted in noting the effect of a specific pollutant for a specific engine load condition. The following data (or equivalent) was compiled and retained by facility personnel:

- Fuel flow at each load (primary and afterburner fuel flow).
- Engine rpm at each load.
- Thrust at each load.
- Engine pressure ratio (EPR).
- Humidity and temperature.

Please note that fuel flow and engine thrust were the most important data items in the above list. The remaining data were important for documentation of engine conditions during sample collection. Due to security issues, EQ was not involved in the collection or review of any engine operating data. This was controlled by LMAS and the SPO.

3.4 JP-8 FUEL SAMPLING AND ANALYSIS

The proximate/ultimate JP-8 fuel analysis and level of nitrogen was determined for the facility in order to verify fuel characteristics during testing. Table 3-4 lists a portion of the fuel analysis that was performed by the facility. During the testing period, EQ collected two fuel samples for metals analysis.

Test Report Section 3 Revision 1 June 2002 Page 16 of 22

Parameter	Analytical Method
Trace Sulfur	ASTM D-2622
Carbon, Hydrogen, and Oxygen	ASTM D-5291
Trace Nitrogen	ASTM 4629 (chemiluminescence)
Heating Value (Net and Gross)	ASTM D-240
Density	ASTM D-1480
API Gravity/Density	ASTM D-1298

TABLE 3-4. JP-8 FUEL ANALYSIS REQUIREMENTS

3.5 ENGINE TESTING MATRIX

3.5.1 Engine Shakedown Runs

Prior to the commencement of emission testing, a preliminary set of gaseous emission and exhaust flow data was determined at each setting. The purpose of the shakedown runs was to determine the expected gaseous pollutant concentrations so that the appropriate calibration gases could be determined. Also, the preliminary flow measurements were used to select the proper sample nozzle diameter.

During the shakedown runs, several measurements were made at multiple idle settings and at several settings that were not planned for the complete test program. The fuel flow was adjusted at small increments, and gaseous emissions were measured at the slipstream rake to note the variance in emissions as fuel flow increased. This provided gaseous emissions data.

3.5.2 Engine Testing

Emissions testing was performed on the F119-PW-100 engine at five power settings. These power settings are the following:

- Idle, 10% power
- Approach, 20% power
- Intermediate, 70% power

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Test Report Section 3 Revision 1 June 2002 Page 17 of 22

- Military, 100% power
- Maximum afterburner, 150% power

Emissions testing was comprised of three 1-hour emissions tests for each pollutant at the idle and approach power settings. Two 1-hour tests were completed at the intermediate and military settings. An oil leak occurred during testing at the intermediate setting, thereby limiting available testing time. The engine had to be allowed to cool and investigated prior to any further testing. The limited testing time did not allow for a third test at intermediate. At the military setting, the engine could be operated continuously for approximately 35 minutes before being shut down for refueling. Due to time constraints for refueling, only two runs were conducted at military; a single 10-minute run for gaseous pollutants only was performed at afterburner. Sample time at afterburner was limited due to fuel constraints and the need to limit engine run time at afterburner.

In addition, a 30-minute sample was collected from the engine rake at the idle and approach settings. At each setting, a sample was collected for approximately 15 minutes at the beginning of the test run; the rake was turned over to the University of Missouri test team who were gathering research data, then sampled again for approximately 15 minutes at the end of the test run.

Due to sample volume and method detection limit requirements, the aldehyde/ketone sample was composited over the 3-hour period. The other particulate matter and volatile samples ran for 1 hour. The engine had to be brought down to a safe operating level so that the test team personnel could access sampling equipment for approximately 10 minutes in between each sample run. All engine settings were defined by Pratt & Whitney so that the engine could be run continuously (or as long as practical) at idle, approach, intermediate, military and afterburner. EQ adjusted the sample collection procedure to accommodate the reduced operating time at the afterburner setting. Ambient air sampling was conducted only during emissions testing. Ambient samples were composited for each of the three 1-hour test runs at that power

Test Report Section 3 Revision 1 June 2002 Page 18 of 22

setting. Table 3-5 lists engine type, number of power settings, and number and types of samples that were collected.

3.5.3 Engine Emission Trend Development

In addition to the settings listed in Table 3-5, an additional sample run from idle to military was conducted. The purpose of the run was to sample for gaseous pollutants throughout the engine power band. The engine throttle position was increased in small increments at approximately 10-minute intervals so that gaseous emission data could be collected at the slipstream rake to develop an emission trend for the engine.

3.6 EMISSION TEST SCHEDULE

Figure 3-1 shows the general time-line for engine testing at the LMAS facility. The time-lines depict activities and the time each activity required for equipment setup, shakedown runs, emissions testing, and demobilization at the test facility.

The following is a breakout of the general tasks conducted during each of the three phases:

- **Equipment setup** Setup and calibration of sampling equipment was completed over 5 days (September 5 through September 10). This involved setting up the exhaust rake and slipstream sampling systems, sampling equipment, tracer gas systems, the flow measurement system, and the mobile laboratory. EQ set-up equipment outside the test stand while other testing was being conducted and the sound exposure was insignificant. There were times when test team personnel needed to enter the test exhaust tube. During this time the test cell was dedicated to equipment setup activities and remained inactive.
- Shakedown During this important period, both the test team and engine test stand operators became familiar with the operational procedures of the test program. The test team gathered preliminary information at each of the engine test settings. This information was vital to ensure that the scheduled test runs were conducted accurately and efficiently. The Shakedown runs were completed on September 11.

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Test Report Section 3 Revision 1 June 2002 Page 19 of 22

TABLE 3-5. ENGINE EMISSION SAMPLING MATRIX

		Sample L	ocation							Engine Setting		
Pollutant/ Method	Engine Rake(B)	Slipstream Rake	Slipstream	Ambient	Sample Duration (A) (Minutes)	Number of Samples per Setting	Total Number of Samples	dia	Annroach	Intermediate	Military	After- burner
Particulate/EPA Method 5202			×		. 09	3,3,2,2	10	×	×	×	×	
Particulate/Team Series 7000 (Real Time)			×		60	3,3,2,2	10	×	×	×	×	
Aldehydes and Ketones/EPA Method 0011			×		180	-	4	×	×	×	×	
VOST/EPA Method 0030			×		60	3,3,2,2	10	×	×	×	×	
Carbon Monoxide/EPA Method 10	×	×		×	60/30	3,3,2,2,1	÷	×	×	×	×	×
Carbon Dioxide and Oxygen/ EPA Method 3A	×	×		×	60/30	3,3,2,2,1	7	×	×	×	×	×
Oxides of Nitrogen/EPA Method 7E	×	×			60/30	3,3,2,2,1	11	×	×	×	×	×
Total Hydrocarbons/ EPA Method 25A	×	×		×	60/30	3,3,2,2,1	11	×	× .	×	×	×
Methane/EPA Method 25A	×	×			60/30	3,3,2,2,1	11	×	×	×	×	×
Particulate/40CFR Part 60, Appendix B				×	. 180	-	υ	×	×	×	×	
Volatile Organic Compounds			-	×	180	-	5	×	×	×		
A ~ 30 minute samples were collected at the engine rake. A 10-min B ~ The engine rake was removed prior to sampling at intermediate.	cted at the e d prior to san	ngine rake. A 1 npling at interme	0-minute samp diate.	le was collec	0-minute sample was collected at afterburner. diate.	ler.						

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Figure 3-1. Time-Line for F119-PW-100 Engine Testing at the Lockheed Martin Aeronautical Systems (LMAS Facility)

M	S .	SD	Ļ	D	
Mobilize	Setup	Shakedown	Test	Teardown	

DAY	DATE		Engine Trend Curve Idle – Intermediate	Idle	Approach	Intermediate	Military & Afterburner	Equipment Teardown
Δ	9/04	M						
Tu	9/04 9/05							
	90/6							
цТ Т	6/07							
Ŀ	9/08							
Sa	60/6	·· 186						
Su	9/10		•					
Σ	9/11	SD	SD					
μ	9/12							
8	9/13							
Th	9/14							
L	9/15		-					٥

Test Report Section 3 Revision 1 June 2002 Page 20 of 22

Test Report Section 3 Revision 1 June 2002 Page 21 of 22

- **Testing** Testing of the engine commenced on September 12. Three runs were completed at the idle and approach settings on this day. Testing at the intermediate setting was completed on September 13. Two runs were completed instead of three due to an oil leak in the engine, which contributed to downtime. The engine was tested at the military and afterburner settings on September 14. The engine could be operated for 35 minutes at military, but then had to be shut down to cool. In addition, after an hour of operation, refueling was required. Due to these time constraints and refueling needs, only two runs at military were completed. The afterburner test was limited to approximately 10 minutes due to fuel constraints and the attempt to limit engine time at afterburner.
- **Teardown** Teardown of the equipment was accomplished in 1 day, September 15.

3.6.1 Personnel Responsibilities

The nature of this test program dictated that the members of the sampling team be highly skilled. The program was staffed at the appropriate level with the necessary skill levels to perform each task. Each team member was actively involved in the collection of emissions samples, fuel samples, sample recovery, data reduction, and sample shipment. Table 3-6 lists the personnel categories and the required qualifications and tasks. The test team functioned as an integrated unit to complete the test program efficiently and without compromising data quality or hush house utilization.

Test Report Section 3 Revision 1 June 2002 Page 22 of 22

TABLE 3-6.	EXAMPLE BREAKOUT OF FIELD TEAM
PERS	ONNEL AND RESPONSIBILITIES

Personnel	Responsibilities/Qualifications
EQ Project Manager	Acted as liaison between LMAS personnel, sample team, Pratt & Whitney and AFIERA/RSEQ. Coordinated engine operation with testing. Assisted in equipment preparation and sample recovery. Collected fuel samples. Set up and constructed sampling equipment.
Weston Team Leader	Assumed technical responsibility for overall sampling effort, sample recovery, and ambient air monitoring. Set up and calibrated equipment. Collected samples and operated FTIR system.
CEM Operator	Operated and calibrated CEM system, electronic flow measurement system, and tracer gas system.
VOST Sample Train Operator	Operated VOST sampling train and assisted other sampling personnel as needed.
Particulate Matter Train Operator	Operated particulate matter sampling train and assisted in sample recovery.
Aldehyde and Ketone Train Operator	Operated aldehyde and ketone sampling train; supervised IATA/DOT certification of shipment of hazardous materials (hazardous sample media, i.e., acetone); and acted as field sample custodian.
Sampling Technician	Provided sampling support to the above personnel.

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Test Report Section 4 Revision 1 June 2002 Page 1 of 12

SECTION 4

CALCULATION OF AIRFLOW

The calculation of emission rates for this test program required accurate measurement of both inlet (ambient) airflow as well as total exhaust flow (combustion products plus excess air). The total exhaust flow was required to quantify mass emission rates for the parameters being measured. The inlet airflow was required to quantify mass rates of any parameter that was measured in the ambient sampling program so that mass rate could be subtracted from the engine emission rate.

Whenever possible, standard EPA flow measurement methods were used to quantify airflow. However, the test location did not provide adequate measurement locations for traditional flow measurements. The following three alternate flow measurement techniques were employed at the location:

- Tracer gas concentration for total exhaust flow.
- Carbon balance for the calculation of inlet and total exhaust flow.
- F-factor for the calculation of inlet and total exhaust flow.

Each method has advantages and disadvantages that vary in significance depending on the specific conditions of each test run. The objective of the test program was to ensure that at least two independent techniques for measuring airflow were available for each test run.

4.1 CALCULATION OF EXHAUST AIRFLOW USING TRACER GAS

4.1.1 Tracer Gas Methodology

Because exhaust flow could not be measured at this location using standard EPA methods, tracer gases were used. The amount of dilution that occurred was determined by inputting a known amount of tracer gas into the exhaust stream and measuring a

Test Report Section 4 Revision 1 June 2002 Page 2 of 12

concentration at the outlet. The dilution rate was then used to calculate exhaust flow rates. This Section details these calculations.

Tracer gas was released from the outside of the hush house at the inlet air screen into the exhaust stream through the ambient air intakes on either side of the hush house.

The tracer gas release points were monitored for temperature. It was important to monitor for temperature since SF₆ is stable up to 500 °F before it degrades. The tracer gas injection apparatus included thermocouples to determine temperatures at the injection point. The 500 °F threshold was very conservative because SF₆ will not decompose until 932 °F. However, EQ intended to maintain the conservative threshold as the point where the tracer method was more seriously examined because of the more extreme conditions that were present in the exhaust stream. Based on test stand operation information gained during site visits conducted prior to testing, it was likely that the temperature in the silencer tube at the tracer release point would exceed 500 °F in intermediate and afterburner modes. However, the temperature limit was not exceeded during testing. Therefore, the alternate methods discussed in Sections 4.2 and 4.3 were completed for comparative purposes.

The tracer gas was released opposite the flow to prevent the exhaust gas pressure from impacting the tracer gas release tubes and possibly affecting tracer gas distribution. Tracer gas was introduced into the stainless steel tubes via a mass flow controller calibrated to SF_6 . The gas flowed into adjustable flow meters that regulated equal amounts of tracer gas into each of the tracer release tubes. Temperature was measured by a Type K thermocouple and recorded by a data logger.

Tracer gas was collected from the same location as the gaseous samples at the slipstream rake (Figure 2-9) in conjunction with each sample run. During the manual sample run, the tracer gas pickup points pulled a sample of exhaust that was analyzed to determine SF_6 concentration. A heated sample line carried the SF_6 directly to the analyzer where it was measured.

Test Report Section 4 Revision 1 June 2002 Page 3 of 12

The tracer gas flow methodology was not used to determine flow at the engine rake. Due to the proximity of the engine rake to the engine, the tracer gas did not have adequate time to mix with the engine exhaust.

This sample location had a single well-defined exhaust augmentor tube but due to its configuration it was difficult to measure by EPA Reference Methods. The exhaust flow was instead calculated from tracer gas dilution ratios. In the tracer gas flow measurement technique, a precise mass flow of the sulfur hexafluoride tracer gas (SF₆) was injected into the exhaust stream after the engine. The SF₆ was injected through four points to obtain good dispersion into the exhaust gas stream. An integrated sample collected at each sampling point at the exhaust location was analyzed for SF₆.

The tracer gas flow calculation is based on the assumption that the SF_6 was dispersed uniformly throughout the exhaust gas. If this assumption is valid, then the following determination is valid simply by mass balance.

 $S_m = Q_s \times C_s \times K$

Where:

 C_s = Average concentration of SF₆ in the exhaust gas. K = Physical constants required to attain consistent units.

Since the SF_6 was distributed uniformly, then the concentration in any sample was equal to the average concentration; thus, by substitution and rearrangement, the following calculation was derived:

$$Q_s \frac{m^3}{min} = \frac{1.64795 \times 10^5 \text{ Sm}}{C_f}$$

Where:

1.6745 x 10³ = Conversion constants times standard molar volume divided by molecular weight of SF₆ $\left[\left(\frac{24.05 \times 10^{-3} \text{ m}^3}{\text{gm-mole}} \right) x \left(\frac{\text{gm-mole}}{146 \text{ gm}} \right) x \left(\frac{10^{-3} \text{g}}{\text{mg}} \right) x \left(\frac{\text{ppb}}{1 \times 10^{-9}} \right) \right]$

Test Report Section 4 Revision 1 June 2002 Page 4 of 12

with units of $\frac{m^3 - ppb}{mg}$

 Q_s = Total exhaust flow, cubic meters per minute (m³/min), wet basis. Sm = Metered injection of SF₆, milligrams per minute (mg/min). C_f = Concentration of SF₆ in sample, parts per billion (ppb).

The flow rate calculation was presented on a metric basis for clarity. All flow rates and emissions were presented in both English and metric units.

The assumption of uniform concentration of the tracer gas is not self-evident in this system and must be proven for each operating condition. The following subsections describe the steps required to prove the assumption, and use of the results to correct other measurements.

4.1.2 Sampling for SF₆ and Determining a Homogeneous Exhaust Mixture

It is not practical to sample the entire engine exhaust to show that the exhaust is homogeneous throughout. Twelve points at the slipstream rake (Figure 2-9) in the exhaust cross section were sampled. Sampling was conducted at each of those points at various engine settings to document that the exhaust stream remained well mixed under several flow scenarios.

4.1.3 Determination of Average SF₆ Concentration

The dilution flow measurement technique requires a well mixed exhaust stream. Simultaneous samples were taken at points in the augmentor tube for all engine operating conditions. The results of the sample analysis were used to calculate an average concentration. A statistical analysis of the data points around this sample average were used to validate this average using the Student's t distribution at a 95% confidence interval. If the sample average satisfied this criterion, the sample average was equal to the true average within the range of the confidence interval for 95 % of all measurements. The range for this evaluation was set at twice the limit of detection (LOD) for the sample analysis.

Test Report Section 4 Revision 1 June 2002 Page 5 of 12

The SF₆ was injected at a rate sufficient to generate a 20-ppb concentration in the well mixed exhaust stream. The LOD for the SF₆ analysis was 0.5 ppb.

4.1.4 Evaluation of Average SF₆ Concentration

After the statistical analysis was completed, the following decision tree was employed:

If the permanent sample point average SF_6 concentrations satisfied the statistical criterion, then the gas stream was well mixed and the average SF_6 concentration measured at the permanent sample points were used to calculate flow rate.

If the sample average SF_6 concentration did not satisfy the statistical criterion, the number of SF_6 injection points were doubled to increase dispersion.

The test program continued on schedule (no further shakedown runs), but the tracer-gas-flow calculation was valid only for those subsequent test runs that met the statistical requirements.

4.1.5 Use of SF₆ Concentration to Adjust Other Sample Results

For those test concentrations where the permanent sampling point average SF_6 concentrations satisfied the statistical criterion, the ratio of the individual permanent sample point concentration to the valid run average was used to determine a corrected average emission rate for that sample.

4.2 CALCULATION OF INLET AND OUTLET AIRFLOW USING A CARBON BALANCE

This method calculates both inlet and outlet airflow rates using a carbon mass balance. This method was used to determine airflow at both the engine exhaust and the total exhaust flow from the hush house. Conservation of matter requires that the total carbon mass rate in the exhaust (MCE) equals the sum of the total carbon mass rate in the fuel (MCF) and the carbon mass rate in the inlet air (MCI).

Test Report Section 4 Revision 1 June 2002 Page 6 of 12

Equation 1

MCE = MCF + MCI

A similar conservation of total mass states that the total mass rate in the exhaust (ME) equals the total mass rate in the fuel (MF) plus the total mass rate at the inlet (MI).

ME = MF + MI Equation 2

Finally, the mass rate of carbon also can be derived as the total mass rate at each location times the percent carbon by weight (% C_x) in each stream.

MCE = ME x % C _e /100	Equation 3
MCF = MF x % C _f /100	Equation 4
MCI = MI x % C _i /100	Equation 5

The percent carbon by weight was measured in all streams and the mass rate of fuel burned also was measured. This leaves four unknown variables, ME, MI, MCE, and MCI, and five independent equations.

To solve for inlet mass flow rate, substitute Equation 2 into Equation 3.

 $MCE = (MF \times \% C_e/100) + (MI \times \% C_e/100)$

Then substitute that equation into Equation 1.

 $(MF \times \% C_e/100) + (MI \times C_e/100) = MCF + MCI$

Substitute Equations 4 and 5 to get:

 $(MF \times \% C_e/100) + (MI \times \% C_e/100) = (MF \times \% C_f/100) + (MI \times \% C_i/100)$

Rearrange factors to get the inlet mass rate.

$$MI = MF\left(\frac{\% C_{f} - \% C_{e}}{100}\right) / \left(\frac{\% C_{e} - \% C_{i}}{100}\right)$$

By similar derivation, rearrange Equation 2, substitute into Equation 5, substitute the results into Equation 1, and then substitute Equations 3 and 4 to get the following:

Equation 2

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Test Report Section 4 Revision 1 June 2002 Page 7 of 12

 $MCI = (ME \times \% C_i/100) - (MF \times \% C_i/100)$ Equation 5 using Equation 2 $MCE = MCF + (ME \times \% C_i/100) - (MF \times \% C_i/100)$ Equation 1 using Equation 5

$$\left(\text{ME x } \frac{\% C_{e}}{100} \right) = \left(\text{MF x } \frac{\% C_{f}}{100} \right) + \left(\text{ME x } \frac{\% C_{i}}{100} \right) - \left(\text{MF x } \frac{\% C_{i}}{100} \right) \qquad Substitute Equations 3 and 4 \text{ME} = \text{MF} \left(\frac{\% C_{f} - \% C_{i}}{100} \right) / \left(\frac{\% C_{e} - \% C_{i}}{100} \right)$$

The mass emission rates can be converted to volumetric flow rates by dividing by molecular weight and multiplying by standard volume. For example:

$$QE = \frac{ME \times 385.35}{MW_{e}}$$

Where:

QE = Wet standard volumetric flow rate,
$$\frac{\text{wscf}}{\text{min}}$$
.
ME = Total exhaust flow rate, $\frac{\text{lb}}{\text{min}}$.
MW_e = Wet molecular weight exhaust stream, $\frac{\text{lb}}{\text{lb mole}}$.
385.35 = Standard molar volume, $\frac{\text{scf}}{\text{lb mole}}$.

The fuel mass rate was measured directly during each test run, and the % was determined by the fuel analysis.

The wet molecular weights of the exhaust gas streams were determined by EPA Reference Methods 3A and 4 (40 CFR 60). These methods measure the percent moisture (% M) of the gas stream and percent carbon dioxide (% CO_2) and oxygen (% O_2) in the gas stream on a dry basis, which were used to calculate the molecular weight as follows:

Test Report Section 4 Revision 1 June 2002 Page 8 of 12

$$MW_{e} = \left[\left\{ (\% CO_{2} \times 0.48) + (\% O_{2} \times 0.32) + ((\% CO_{2} + \% N_{2}) * 0.28) \right\} * \left(1 - \frac{\% M}{100} \right) \right] + (\% M \times 0.18)$$

Where:

% M = Moisture content as a percent.

For the purpose of calculating a molecular weight, ($\% \text{ CO} + \% \text{ N}_2$) was assumed to be (1 - $\% \text{ CO}_2$ - $\% \text{ O}_2$). Calculation of the carbon content of the exhaust gas stream used the $\% \text{CO}_2$ as determined by Method 3A, plus additional measurements of carbon monoxide (% CO) and total hydrocarbons (% THC) by EPA Reference Methods 10 and 25A (40 CFR 60, Appendix A). The % THC was stated on the basis of methane (CH₄). The carbon monoxide (CO) and carbon dioxide (CO₂) concentrations were measured on a dry basis and converted to a wet basis using the measured moisture content of the exhaust gas. THC was measured on a wet basis.

% CO₂ (wet) = % CO₂ (dry) x
$$\left(1 - \frac{\% M}{100}\right)$$

% CO (wet) = % CO (dry) x $\left(1 - \frac{\% M}{100}\right)$

The total carbon content of the exhaust gas stream is equal to the sum of % CO₂, % CO, and % THC on a wet basis times the ratio of carbon molecular weight to the total wet molecular weight of the gas stream.

% C_e = (% CO₂ wet + % CO wet + % THC) x
$$\frac{12.01}{MW_e}$$

A similar calculation was required for the inlet air volumetric flow rate, but the following simplifying assumptions were made:

- Dry ambient air is composed of 20.9% oxygen and 79.1% nitrogen.
- Ambient humidity represents the moisture content of the inlet air.

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Test Report Section 4 Revision 1 June 2002 Page 9 of 12

The major drawback to this measurement method was the use of extremely low carbon concentration values at the inlet, and relatively low concentrations at the exhaust to modify the very high carbon concentrations in the fuel. As excess air increases, the inlet flow was indistinguishable from the outlet flow. The major advantage of this procedure was that the only additional data that are required to calculate flow are: the inlet flow; CO, CO₂, and THC values; and ambient humidity.

4.3 CALCULATION OF AIRFLOW USING F-FACTORS

F-factors relate the volume of combustion products to the heat content of fuel. F-factors generally are used for combustion sources when the exhaust stream flow rate is known but the fuel heat input must be determined. In this case, the fuel input was determined easily but the volumetric flow of combustion air was difficult to determine. The F-factor relationship was used to calculate the total exhaust flow at the engine rake and at the hush house exhaust based on a fuel firing rate.

F-factors are published for a variety of fuels and usually are expressed in units of dry standard cubic feet per British thermal unit (dscf/Btu or dscm)/joule (J). For this test program, specific F-factors were determined through historic ultimate analysis of the fuel components on a weight percent basis and fuel density.

• Ultimate analysis of jet fuel (i.e., hydrogen, carbon, sulfur, nitrogen, oxygen, and density (pounds per gallon [lb/gal]) on a mass basis (% wt).

To determine the air volumetric flow rate, the following additional information was required:

- The concentrations of oxygen, carbon monoxide, and moisture content in the exhaust stream after combustion.
- Fuel firing rate, gallons per minute (gal/min).

The F-factor, dry basis, was calculated from the ultimate analysis of the jet fuel as follows:

$$F_d = K[(K_{nd} \% H) + (K_c \% C) + (K_s \% S) + (K_n \% N) - (K_o \% O)]/GCV$$

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Test Report Section 4 Revision 1 June 2002 Page 10 of 12

(Equation 19-13, 40 CFR 60, Appendix A, Method 19)

If the heat input components (K, GCV) were eliminated from the equation, an Ffactor based on fuel mass was derived.

 $F_{md} = [(K_{hd} \% H) + (K_c \% C) + (K_s \% S) + (K_n \% N) - (K_o \% O)]$

Where:

F_d = Volume of combustion components per unit of heat content, scf/million Btu.
 F_{md} = Volume of combustion component on a dry basis per pound of fuel, scf/lb.
 % H, % C, % S, % N, % O = Weight percents of hydrogen, carbon, sulfur, nitrogen, and oxygen in the jet fuel.

 $\begin{array}{l} \text{GCV}=\text{Gross calorific value of the fuel consistent with the ultimate analysis,} \\ \text{Btu/lb.} \\ \text{K}=\text{Conversion factor, } 10^{-5}. \\ \text{K}_{hd}=3.64~(\text{scf/lb})/(\%). \\ \text{K}_{c}=1.53~(\text{scf/lb})/(\%). \\ \text{K}_{s}=0.53~(\text{scf/lb})/(\%). \\ \text{K}_{n}=0.14~(\text{scf/lb})/(\%). \\ \text{K}_{o}=0.46~(\text{scf/lb})/(\%). \end{array}$

Stoichiometric combustion calculations assume that the carbon in the fuel is burned completely to produce carbon dioxide and water with no excess air (and no significant formation of nitrogen dioxide or carbon monoxide). The air stoichiometric volumetric flow rate (dry basis) was determined by simply multiplying the measured fuel firing rate by the F-factors.

$$\left(\text{Fuel firing rate, } \frac{\text{gal}}{\min} \right) \left(\text{fuel density, } \frac{\text{lb}}{\text{gal}} \right) \left(F_{\text{md}}, \frac{\text{scf}}{\text{lb}} \right)$$

= dry combustion air flow, $\frac{\text{scf}}{\min}$

The percent excess air (EA) during actual combustion was calculated using the following formula:

Test Report Section 4 Revision 1 June 2002 Page 11 of 12

% EA =
$$\left[\frac{\% O_2 - 0.5\% CO}{20.9 - (\% O_2 - 0.5\% CO)}\right] x 100$$

Where:

% O_2 , % CO = Measured percents of oxygen, and carbon monoxide, in the exhaust gas. 20.9 is the percent dry oxygen in ambient air.

Total dry combustion flow (including) excess air equals:

Total dry air flow =
$$\left[(dry \text{ combustion air flow}) \left(1 + \frac{\% \text{ EA}}{100} \right) \right]$$

This simplifies to:

Total dry combustion flow,
$$\frac{\text{scf}}{\text{min}} = (\text{dry combustion air}) \\ * \left(\frac{20.9}{20.9 - \% O_2 + 0.5 \% \text{CO}}\right)$$

The inlet airflow is equal to the total dry combustion air plus the fraction of oxygen in the inlet used for the combustion of hydrogen in the fuel. The nitrogen associated with this oxygen fraction of the inlet air was included in the F_d calculation.

This inlet oxygen fraction can be derived from the same F-factor calculations presented in EPA Method 19.

 $F_{mo} = K [K_{hi} \% H]$

Where:

 F_{mo} = Volume of inlet oxygen used to combust hydrogen per unit of fuel fired, scf/lb.

 $K_{hi} = 0.96 (scf/lb)/\%$.

% H = Weight percent of hydrogen in the fuel as stated previously.

Then the total dry inlet airflow is the following:

Test Report Section 4 Revision 1 June 2002 Page 12 of 12

Dry inlet air =
$$\left[\text{fuel firing rate, } \frac{\text{gal.}}{\text{min}} \right] \left[\text{fuel density, } \frac{\text{lb}}{\text{gal.}} \right] \left[F_{\text{md}} + F_{\text{mo}} \right] \\ * \left[\frac{20.9}{20.9 - \% O_2 + 0.5 \% \text{CO}} \right]$$

The inlet air then can be corrected back to actual conditions using the ambient temperature and humidity. The total exhaust flow can be adjusted to actual conditions using the measured exhaust moisture content and temperature.

There are limitations to the use of these F-factors for calculations of airflow from jet engines. The concentration of carbon monoxide in the combustion stream normally is so low that it is insignificant in the excess air calculation, but it has been included to cover operation during periods of incomplete combustion. If the combustion is so incomplete that large quantities of the fuel are exhausted as carbon (soot) or volatile hydrocarbons (THC), the % C of the fuel must be reduced to account for the reduced formation of combustion products.

The second limitation arises when high levels of excess air are present. At high excess air levels, the carbon monoxide concentration becomes zero, but the oxygen content of the combustion gas approaches ambient concentrations ($20.9 \% O_2$). The excess air equation becomes unreliable at a concentration of 20.9 % oxygen as this equation is undefined due to division by zero. As a general rule, these F-factor calculations will be unreliable any time the combustion gas contains more than 18.5 % oxygen.

Test Report Section 5 Revision 1 June 2002 Page 1 of 20

SECTION 5

QUALITY ASSURANCE PROCEDURES

5.1 QUALITY CONTROL PROCEDURES

As part of the engine testing program, EQ implemented a quality assurance (QA) and quality control (QC) program. QA/QC were defined as follows:

- <u>Quality Control</u> The overall system of activities whose purpose was to provide a quality product or service (e.g., the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process).
- <u>Quality Assurance</u> A system of activities whose purpose was to provide assurance that the overall QC was being conducted effectively.

The Field Team Leaders for stack sampling were responsible for implementation of field QA/QC procedures. Individual laboratory managers were responsible for implementation of analytical QA/QC procedures. The overall Project Manager oversaw all QA/QC procedures to ensure that sampling and analyses met the QA/QC requirements and that accurate data results from the test program were obtained.

5.1.1 Field QC Sample Collection/Preparation Procedures

Table 5-1 provides a summary of the numbers and types of field and analytical

QA/QC samples by parameter. General field QC procedures were the following:

- Collect only the number of samples needed to represent the media being sampled.
- To the extent possible, the quantities and types of samples and sample locations were determined prior to the actual field work.
- As few people as possible handled the samples.

June 2002 Page 2 of 20 Test Report Section 5 Revision 1

TABLE 5-1. SUMMARY OF ANALYTICAL QA/QC SAMPLES

SAMPLE LOCATION	PARAMETER	NUMBER OF SAMPLES	TYPES OF QA/QC SAMPLES	QC SAMPLES	
			FB	TB	MS
EXHAUST SAMPLES ⁽¹⁾ .	.(1).		and the second se		
	Particulate	48	-	-	
	Volatile organics ⁽²⁾	48	1 pair	1 pair	12 pair
	Aldehydes and	4			-
-	Ketones				
AMBIENT (BACKGROUND)	DUND)				
	Particulate	4			
	Volatile organics	5	~	ł	E B
⁽¹⁾ Trip blanks for	⁽¹⁾ Trip blanks for exhaust samples consisted of reagent blanks. See Subsection 5.1.2 for a	isisted of reagent	blanks. See Sub	section 5.1.2 for a	

description of exhaust blank samples. ⁽²⁾ Four VOST tubes per test run. FB = Field Blank TB = Trip Blank MB = Method Blank or Preparation Blank MS = Matrix Spike

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Test Report Section 5 Revision 1 June 2002 Page 3 of 20

- The field sampler was personally responsible for the care and control of the samples collected until they were property transferred or dispatched.
- Sample records were completed for each sample, using black waterproof ink
 or other measures to ensure the legibility and integrity of sample
 identification.
- The Field Team Leader ensured that proper preservation, storage, and security procedures were followed during the field work and decided if additional samples were needed.
- Storage conditions of samples were documented on the sample forms or project records.

5.1.1.1 QC Procedures for Stack Gas Sample Collection

This subsection provides a list of QC procedures employed during the field sampling effort. Method-specific QC procedures are detailed in the method descriptions contained in Appendix A. General QC checks that apply to all methods include the following:

- Leak checks.
- Use of standardized forms, labels, and checklists.
- Ensure sample traceability.
- Collection of appropriate blanks.
- Use of calibrated instrumentation.
- Use of Protocol 1 and/or NIST-traceable calibration gases.
- Review of data sheets in the field to verify completeness.
- Use of validated spreadsheets for calculating results.

5.1.1.2 Velocity/Volumetric Flow Rate QC Procedures

Volumetric flow rates were determined during the isokinetic stack gas tests. The

following QC procedures were followed during these tests:

- The S-type pitot tube was inspected visually before sampling.
- Both legs of the pitot tube were leak-checked before sampling.
- Proper orientation of the S-type pitot tube was maintained while making measurements. The yaw and pitch axes of the S-type pitot tube were maintained at 90° to the flow.

Test Report Section 5 Revision 1 June 2002 Page 4 of 20

- The manometer oil was leveled and zeroed before each run.
- Cyclonic or turbulent flow checks were performed prior to testing the source.
- Pitot tube coefficients were determined based on physical measurement techniques as delineated in EPA Method 2.

5.1.1.3 Moisture Content and Sample Volume QC Procedures

Gas stream moisture was determined by EPA Method 4 as part of the isokinetic stack gas tests. The following QC procedures were followed in determining the volume of moisture collected:

- The balance zero was checked and rezeroed if necessary before each weighing.
- The balance was leveled and placed in a clean, motionless environment for weighings.
- The indicating silica gel was fresh for each run and was inspected periodically and replaced during runs, if needed.

The QC procedures that were followed to ensure accurate sample gas volume determination were the following:

- The dry gas meter was fully calibrated annually using an EPA-approved intermediate standard device.
- Pretest, port-change, and posttest leakchecks were completed (must be less than 0.02 cfm or 4 % of the average sample rate).
- The gas meter was read to the thousandth of a cubic foot for all initial and final readings.
- Readings of the dry gas meter, meter orifice pressure (Delta H), and meter temperatures were taken at every sampling point.
- Accurate barometric pressures were recorded at least once per day.
- Pre- and posttest program dry gas meter checks were completed to verify the accuracy of the meter calibration constant (Y).

Test Report Section 5 Revision 1 June 2002 Page 5 of 20

The most critical operating parameter for ambient air-sampling equipment was the airflow rate during sampling, which determines the total volume of air sampled. Calibrations of the ambient air-sampling equipment were performed to accurately determine the operating flow rates of the samplers, and to verify that all method-based flow-rate requirements were met.

All ambient air samplers were calibrated upon installation to establish the means for determining operating flow rates, and as required throughout the monitoring program whenever field calibration checks or repairs required recalibration. All calibrations were conducted according to standard operating procedures (SOP), using materials traceable to NIST reference materials. Calibrations were conducted by qualified personnel thoroughly familiar with the sampling equipment. All calibration and audit results were recorded in a field logbook and/or the calibration/audit data sheets. Other specific QA/QC for particulate, VOST, aldehydes and ketones, and CEMS are included in Appendix B.

5.1.2 Exhaust Gas Blank Samples

Stack gas blank samples consisted primarily of reagent blanks collected in the on-site sample recovery area during the test program. Reagent blanks included solvents used to recover stack samples, absorbing solutions, filters, and resins (Tenax, Tenax/charcoal). All reagent blanks were collected by transferring directly from storage containers to sample jars, or labeling filters and resins as blank samples.

For the VOST Method 0030[°] sampling trains, additional blank samples were taken in the field according to the following procedures. Blank Tenax and Tenax/charcoal cartridges were taken to the sampling location and the end caps removed for a period of time equal to the time required to exchange one pair of VOST tubes on the VOST train. After this time period, the end caps were replaced on the blank tubes and these tubes were handled in a manner similar to the other VOST tube

⁴⁰ CFR 60 Appendix A

Test Report Section 5 Revision 1 June 2002 Page 6 of 20

A blank Method 0011* (aldehydes and ketones) sample train was taken to the stack sample location, leak checked, and then recovered in the same manner as the Method 0011* stack samples.

The sampling media may contain small amounts of the target compounds emitted from naturally occurring or anthropogenic emission sources. Contamination may be introduced to the sampling media during handling of the media in the laboratory, in the field, or during shipping. Blank samples were used to quantify these sources of contamination. A blank sample consisted of a complete set of sampling media (e.g., a PUF cartridge and a glass fiber filter, or a complete ADS sampling train) that has had no air drawn through it by the sampling equipment. Field blank samples were collected during the monitoring program.

The field blanks were used to identify contamination resulting from field sample handling procedures. A field blank was handled in the same manner as an actual sample, undergoing the same preparation, installation in the sampler module, and recovery procedures.

The following stack sample blank corrections were performed.

- Particulate Acetone and methylene chloride blank.
- VOST Field and trip blanks.
- Aldehydes and Ketones Reagent blanks.

5.2 SAMPLING CONTAINERS, PRESERVATIVES, AND VOLUME REQUIREMENTS

Table 5-2 lists the holding times, storage containers and preservation requirements used for routine storage and handling of samples.

5.3 DECONTAMINATION PROCEDURES

Stack-gas sampling equipment was precleaned following standard source test. method procedures. All stack-gas sampling equipment was cleaned on site as part of individual sample recovery procedures. Test Report Section 5 Revision 1 June 2002 Page 7 of 20

TABLE 5-2. RECOMMENDED SAMPLE CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

SAMPLE LOCATION	ANALYTE	MATRIX	CONTAINER TYPE AND SIZE	PRESERVATION	HOLDING TIME
ENGINE EXHAUST	Particulate Condensable	Liquids, Filters,	AG/500 mL AG/1.0 L	NA NA	NA
	particulate Volatile organics	and resins	G/40 mL AG/1L	≤4 °C ≤4 °C	14 days 14 days to exit/40 days to analysis
	Aldehydes and Ketones	Liquid	AG/1.0 L	≤4 °C	14 days
AMBIENT	Particulate Volatile organics	Filter Whole air Filter/PUF	E S G/A	NA NA 4 ± 2°C	NA 30 days 7 days to exit/40 days to analysis

Key:

A= Aluminum Foil AG = Amberglass D = Denuder Tube E = Envelope/Folder G = Glass NA = Not Applicable P = Plastic S = Stainless Steel Canister.

Test Report Section 5 Revision 1 June 2002 Page 8 of 20

Sample containers were purchased from a vendor with a certificate indicating that each lot of bottles was free of contaminants.

All personnel associated with sample collection used designated personal protective equipment (PPE). Personnel followed standard PPE decontamination procedures for each level of PPE required.

All personnel received the proper hazardous materials training as specified in 29 CFR 1910.

5.4 SAMPLING PACKAGING AND SHIPMENT

All samples were packaged and shipped according to the specifications detailed in the Hazardous Materials Transportation Regulations published by the U.S. Department of Transportation (DOT) (49 CFR 171-180) for ground transportation and the International Air of collection, shipment, laboratory receipt, and laboratory custody until disposal was documented to accomplish this objective. Documentation was accomplished through a chain-of-custody record that documents each sample and the individuals responsible for Transport Association (IATA) regulations for air shipment. These regulations contain detailed instructions on how hazardous materials must be identified, packaged, marked, labeled, documented, and placarded. All personnel involved with sample shipment were trained and certified for shipment of hazardous materials.

When transferring possession of samples, the individuals relinquishing and receiving those samples signed, dated, and noted the time on the sample chain-of-custody record. This record documents sample transfer from the sampler, often through another person or commercial carrier, to the sample custodian or analyst.

The procedure for shipping samples was as follows:

- A complete sample inventory form (chain-of-custody) was enclosed with the samples being shipped, and a copy retained by the Field Team Leader.
- DOT and IATA regulations were followed for shipping container requirements. The regulations require that the shipper make a reasonable determination whether the sample is classified as a hazardous material and, if so, that it is appropriately identified.

Test Report Section 5 Revision 1 June 2002 Page 9 of 20

- Each package was designed and constructed, and its contents limited, so that under normal transportation conditions there was no significant release of materials to the environment and no potentially hazardous conditions.
- Samples were placed inside a shipping container for transport back to the laboratory.
- Preservation of the samples (e.g., refrigerant packs, ice, chemical preservatives, etc.) was performed as required by the test plan or analytical requirements and documented on the sample inventory record.

All freight bills and shipping records were retained as part of the permanent records by the Project Manager.

5.5 CUSTODY PROCEDURES

An overriding consideration for environmental measurement data was the ability to demonstrate that samples have been obtained from the locations stated using the prescribed methods and that they have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal was documented to accomplish this objective. Documentation was accomplished through a chain-of-custody record that documents each sample and the individuals responsible for sample collection, shipment, and receipt. A sample was considered "in custody " under the following conditions:

- It was in a person's actual possession.
- It was in view after being in physical possession.
- It was secured in a locked compartment so that no one could tamper with it after it had been in physical custody.
- It was in a secured area, restricted to authorized personnel.

5.5.1 Field Custody Procedures

Sample custody was initiated by EQ during collection of the samples. Preformatted labels were used at the time of collection. Documents prepared specifically for monitoring

Test Report Section 5 Revision 1 June 2002 Page 10 of 20

field sample collection and recovery were used for recording pertinent information about the types and numbers of samples collected and shipped for analysis. The samples collected first were assembled at an on-site location for batching and paperwork checks. This task included matching similar sample types (e.g., solids, liquids) from all sampling locations. Sample packaging procedures complied with all DOT and IATA requirements for shipment of environmental samples. Establishing or maintaining sample integrity involved numerous steps or considerations in addition to custody documentation. For example, major concerns in programs of this nature were contamination, cross-contamination, and/or degradation of sample containers; absorbing and filtration media; recovery materials; and actual samples, as applicable. These problems were avoided or minimized <u>at all times</u> by using the following procedure:

- The lid of each labeled jar was secured with a strip of custody tape.
- Individual sample jars were then sealed in plastic bags and placed in appropriate shipping containers.
- Volatile materials were stored, handled, and transported apart from sorbent materials (e.g., store, handle, and ship VOST tubes apart from solvents [methylene chloride, acetone, toluene, etc.] used to recover the other sample trains).
- Volatile, organic, and aldehyde and ketone samples were sealed and kept away from sources of solvents, gasoline, etc., during recovery, transportation, storage, and analysis (e.g., recovery of particulate samples where acetone is used was performed remote from preparation, recovery, and storage of VOST and aldehyde and ketone samples).
- Vermiculite was placed around the bags in the shipping container for protection from damage, if needed. Ice was placed in the shipping container, if required.
- One chain-of-custody form was completed for each shipping container, placed in a large plastic bag, and the bag taped to the inside lid of the shipping container.
- The container was taped closed with tape and sealed with custody tape on two sides such that opening the container broke the custody tape.

Collected samples were kept under lock and key or within sight at all times until their shipment to the laboratory. The field sampler acted as the sample custodian and the

Test Report Section 5 Revision 1 June 2002 Page 11 of 20

document control officer in order to monitor the location of collected samples and to record vital sample information in field logbooks.

A unique system for individual sample identification was used. Table 5-3 provides a legend of the identification system for stack gas samples and some examples. The identification code was included on each sample label.

A uniform sample identification system was used in the ambient air-monitoring program. All samples were identified using the following format:

Ussssss - mmddyy - ppp(n) - qq

Where

U ssssss	Indicates United States Air Force; Monitoring site designator: Operation mode and engine type (e.g., ATF101 - Approach, Tinker, F101-GE-102)
mm	Sample month, two digits
dd	Sample day of month, two digits
уу	Sample year, last two digits
ppp	Pollutant/media identification code (two or three characters):
	VOC - Volatile Organic Compounds
	PM - Particulate Matter
	PAH - Polynuclear Aromatic Hydrocarbons
	DNP - DNPH-coated annular denuder (aldehydes and ketones)
n	Sequence number, only used for multimedia sampling trains
qq	Quality assurance sample identifier (one or two characters): FB - Field blank

For example, a sample identified as UP-110599-PM-FB indicates the first particulate matter filter field blank at Lockheed Martin, which ran on 05 November 1999.

This naming convention allows every sample to be completely and consistently identified on the field data sheets, sample media labels, chain-of-custody forms, and laboratory reports. The naming convention was designed to provide redundant

Test Report Section 5 Revision 1 June 2002 Page 12 of 20

TABLE 5-3. LEGEND FOR SAMPLE IDENTIFICATION SYSTEM

•				SAM STACI	SAMPLE TYPE STACK SAMPLES
PROJECT NAME	MODE	SAMPLE LOCATION	RUN NUMBER	METHOD	FRACTION
AF (United States Air Force)	l (idle)	PF119 (Pratt & Whitney F119-PW-100)	-	M5 (particulate)	FHA (front half acetone)
	A (approach)		2	M0030 (volatiles)	Filt (filter)
	N (intermediate)		ĸ	M0011 (aldehydes and ketones)	BHW (back half water)
	M (military)		FB //=		BH MeCl ₂ (back half MeCl ₂)
			(Tield Diank)		
	B (after burner)		TB		FHS (front half solvent)
			(trip blank)		
	01		a		BHS (back half solvent)
-	(other power setting 1)		(duplicate)		
	02				TP (tube pair)
	(other power setting 2)				
	03				COND (VOST condensate)
	(other power setting 3)				
					SB (stack blank)
					TB (trip blank)
			-		

EXAMPLES: AF-A-PF119-1-M5-FHA = United States Air Force, Approach, Pratt & Whitney, F119-PW-100, Run 1, Method 5, Front Half Acetone

Test Report Section 5 Revision 1 June 2002 Page 13 of 20

information that can be used in conjunction with laboratory media identification numbers to verify sample identity.

The final evidence file includes at a minimum the following:

- Field logbooks.
- Field data and data deliverables.
- Photographs.
- Drawings.
- Laboratory data deliverables.
- Data validation reports.
- Data assessment reports.
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (i.e., tags, forms, airbills, etc.).

5.6 CALIBRATION PROCEDURES AND FREQUENCY

This subsection describes the calibration procedures and the frequency at which

these procedures were performed for both field and laboratory instruments.

5.6.1 Field Instrument Calibration

The following equipment items were calibrated before and after field usage:

- Velocity measurement devices.
- Gas flow rate metering systems.
- Gas volume metering equipment.
- Gas composition measuring apparatus (Orsat).

The calibration records include device numbers, calibration dates, methods, and

data and results, and are maintained on file at the Weston laboratory. Copies of applicable calibration records also were available at the job site for review.

Acceptance limits are shown for each equipment item in Table 5-4.

5.7 DATA REDUCTION, VALIDATION, AND REPORTING

Data was produced primarily from three sources, specifically the following:

 Engine operations during the test program (classified information that was gathered and retained by Pratt & Whitney).

Test Report Section 5 Revision 1 June 2002 Page 14 of 20

- Field measurements data, including sampling records (volumes and duration), and observations.
- Sample analysis and characterization data.

All data generated by field activities or by the laboratory was reduced and validated prior to reporting. Specific data reduction, validation and reporting procedures are described in the following subsections.

5.7.1 Data Reduction

5.7.1.1 Field Data Reduction Procedures

The stages of data confirmation began with an initial series of calculations completed

on the <u>same day</u> as the sampling effort to establish that the pretest assumptions were correct and that the test procedures completed to that point were performed in an acceptable manner. This enabled the on-site test team to correct any faulty procedures, and provided a greater understanding of immediate problems. The on-site data reduction and confirmation activities were performed by an experienced data management specialist.

5.7.1.2 Office Calculations

All data averages were "double-checked" to verify numerical accuracy by an experienced technician. Prior to utilization of the analytical data for calculation of test results, a check was applied to ascertain any obvious "out-of-line" results for reanalysis. All results of calculations were examined by another individual as assigned by the Field Team Leader. Depending on the complexity of the work, this person either spot-checked certain calculations or repeated the entire effort as assigned by the Field Team Leader. When all data was summarized, a check was made for test result correctness by the Field Team Leader and by the EQ Program Manager. The EQ or Weston QA Manager

Test Report Section 5 Revision 1 June 2002 Page 15 of 20

TABLE 5-4. ACTIVITY MATRIX FOR CALIBRATION OF EQUIPMENT^a

APPARATUS	ACCEPTANCE LIMITS	FREQUENCY AND METHOD OF MEASUREMENT	ACTION IF REQUIREMENTS WERE NOT MET
Wet test meter	Capacity 3.4 m ³ /hr (120 ft/hr); accuracy within ±1.0%	Calibrate initially, and then yearly by liquid displacement.	Adjust until specifications are met, or return to manufacturer.
Dry gas meter	$Y_1 = Y \pm 0.02 Y$	Calibrate vs. wet test meter initially, and when posttest check exceeds Y ± 0.05 Y	Repair, or replace and then recalibrate.
Thermometers	Impinger thermometer $\pm 1^{\circ}$ C (2°F); dry gas meter thermometer $\pm 3^{\circ}$ C (5.4°F) over range; stack temperature sensor $\pm 1.5\%$ of absolute temperature	Calibrate each initially as a separate component against a mercury-in-glass thermometer. Then before each field trip compare each as part of the train with the mercury-in-glass thermometer.	Adjust to determine a constant correction factor, or reject.
Probe heating system	Capable of maintaining $120^{\circ} \pm 14^{\circ}$ C (248° ± 25°F) at a flow rate of 20 l/min (0.71 ft ³ / min)	Calibrate component initially by APTD-0576(11) if constructed by APTD-0581(10), or use published calibration curves.	Repair or replace and then reverify the calibration.
Barometer	±2.5 mm (0.1 in.) Hg of mercury-in-glass barometer	Calibrate initially vs. mercury-in- glass barometer; check before and after each field test.	Adjust to agree with a certified barometer.
Probe nozzle	Average of three ID measurements of nozzle; difference between high and low 0.1 mm (0.004 in.)	Use a micrometer to measure to nearest 0.025 mm (0.001 in.); check before field test.	Recalibrate, reshape, and sharpen when nozzle becomes nicked, dented, or corroded.
Type S pitot tube and/or probe assembly	All dimension specifications met, or calibrate according to Subsection 3.1.2, and mount in an interference-free manner	When purchased, use method in Subsections 3.1.1 and 3.1.2; visually inspect after each field test.	Do not use pitot tubes that do not meet face opening specifications; repair or replace as required.
Stack gas temperature measurement system	Capable of measuring within 1.5% of minimum absolute stack temperature	When purchased and after each field test, calibrate against ASTM thermometer.	Adjust to agree with Hg bulb thermometer, or construct a calibration curve to correct the readings.
Analytical balance	±1 mg of Class-S weights	Check with Class-S weights upon receipt.	Adjust or repair.

(continued)

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Test Report Section 5 Revision 1 June 2002 Page 16 of 20

TABLE 5-4 (continued)

APPARATUS	ACCEPTANCE LIMITS	FREQUENCY AND METHOD OF MEASUREMENT	ACTION IF REQUIREMENTS WERE NOT MET
Differential pressure gauge (does not include inclined manometers)	Agree within ±5% of incline manometers	Initially and after each field use.	Adjust to agree with inclined manometer or construct calibration curve to correct the readings.
Orsat analyzer	Average of three replicates should be $20.9 \pm 0.5\%$ (absolute) or known concentration ± 0.5 (absolute)	Upon receipt and before any test in which the analyzer has not been checked during the previous 3 mo; determine $\% O_2$ in ambient air, or use a calibration gas with known CO, CO ₂ , and O ₂ concentrations	Check Orsat analyzer for leaking valves, spent absorbing reagent, and/or operator techniques. Repair or replace parts or absorbing solutions, and/or modify operator techniques.
Rotameter or rate meter	Smooth curve of rotameter actual flow rates with no evidence of error. $\pm 5\%$ of known flow rate.	Check with wet test meter or volume meter at 6-month intervals or at indication of erratic behavior.	Repeat calibration steps until limits were attained.

 ^a EPA-600/9-76-005, Quality Assurance Handbook for Air Pollution Measurement Systems - Volume III, U. S. EPA, Office of Research and Development, Environmental Monitoring and Support Laboratory, Research Triangle Park, NC, January 1976, as revised.

Test Report Section 5 Revision 1 June 2002 Page 17 of 20

conducted routine audits to document that the checks were being performed and documented (with checker's initials and date).

The initial field test data and resulting calculations were performed on a portable PC at the end of each test day. In the office, final results and result tables were developed on a microcomputer. Standard EPA method programs have been developed and validated for the computational systems to ensure that correct equations were utilized to generate results. The programs list all entry items (for proofing purposes) and produce calculated results in hard copy form. Reference method equations were used to calculate the concentration and/or mass rate of each measured parameter.

5.7.2 Analytical Data Validation Evaluation

All data was compared to the acceptance criteria of the reference method. For example, particulate tests must be 100% isokinetic, $\pm 10\%$, to be acceptable. Laboratory data was acceptable only if calibration standards fell within the established control limits.

Outliers were treated on a case-by-case basis. All questionable data were reviewed in an attempt to find a reason for rejection.

Analytical data was appropriately qualified in the scientific and technical report. Case narratives were prepared, which include information concerning data that fell outside acceptance limits, and any other anomalous conditions encountered during sample analysis. After the Laboratory QA Officer approved these data, they were considered ready for data validation.

5.7.2.1 Procedures Used To Evaluate Field Data

Procedures used to evaluate field data included posttest field instrument calibration checks, acceptable isokinetic sampling rates, and demonstration of acceptable posttest leak checks.

Test Report Section 5 Revision 1 June 2002 Page 18 of 20

5.7.3 Data Reporting

Data reporting procedures were performed for field operations as indicated in the following subsections.

5.7.3.1 Field Data Reporting

Field data reporting were conducted principally through the generation of test data tables containing tabulated results of all measurements made in the field, and documentation of all field calibration activities.

5.8 PREVENTIVE MAINTENANCE REVIEW

Well-maintained equipment was an essential ingredient in ensuring the quality, completeness, and timeliness of the field and analytical data. This subsection reviews the schedules of preventive maintenance that were performed to minimize the downtime for critical measurement systems for each contracting company. Also, lists of critical spare parts that were available at the individual field and laboratory sites was developed and reviewed. This subsection represents a review of the preventive maintenance items that were required for the field operations.

5.8.1 Field Instrument Preventative Maintenance

Field source testing equipment and instrumentation that required maintenance and/or calibration were serviced immediately prior to conducting the test program.

Normal spare parts (e.g., control consoles, sample boxes, probes, glassware, sample bottles, etc.) as well as extra materials/supplies (e.g., filters, solutions, solvents, XAD traps, etc.) were scheduled to be available at the field site during testing.

Extra spare parts and equipment for process sample collection and compositing equipment, glassware, sample containers, etc. were scheduled to be available at the field site during testing. Extra materials/supplies (e.g., filters, solvents, etc.) required for the process sample collection were also available at the field site during testing.

Test Report Section 5 Revision 1 June 2002 Page 19 of 20

Sufficient volumes of protocol and calibration gases for the CEM monitoring, extra fittings, sample lines, pumps, heating tapes, and analyzer cells, along with sufficient materials/supplies (e.g., pump oil, filters, etc.) were available at the field site during testing.

5.9 CORRECTIVE ACTION

Corrective action was the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or procedures out of QC performance that could affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective actions proposed and implemented was documented in the regular QA reports to management. Corrective action was implemented only after approval by the EQ Project Manager or his designee. If immediate corrective action was required, approvals secured from the EQ Project Manager were documented in an additional memorandum.

Depending on the nature of the problem, the corrective action may be formal or informal. In either case, occurrence of the problem, the corrective action performed, and verification that the problem had been resolved were documented. Whenever a corrective action was required, documentation was completed by the individual noting the problem and a copy was filed with the EQ Project Manager.

The shared effort for implementing the corrective action was the responsibility of the EQ Project Manager, the EQ QA Managers, and the Field Team Leaders.

Corrective actions were initiated when data quality problems were determined during the program. These data quality problems were flagged "out of control" if they were outside the predetermined limits specified above for internal, performance, system, and data audits. When discovered, prompt action toward a solution was undertaken by the generator of the data. The corrective action was conducted through the following six activities:

- Define the quality problem.
- Notify the designated individuals listed in the work plan.
- Determine the cause of the problem.

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Test Report Section 5 Revision 1 June 2002 Page 20 of 20

- Determine the corrective action.
- Implement the corrective action.
- Verify the solution to the problem.

Corrective action was instituted immediately by the individual noting a problem in a measurement system. An unresolved problem was reported to the EQ Project Manager and the EQ QA Managers for further action.

Test Report Section 6 Revision 2 June 2002 Page 1 of 36

SECTION 6

RESULTS

F119-PW-100 aircraft engine exhaust emissions were characterized to determine the concentration, mass emission rate and emission factor relative to fuel flow for criteria and select hazardous air pollutants. Sampling was performed for nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO₂), non-methane hydrocarbons (NMHC), particulate matter (PM), particle size characterization, aldehyde and ketones and volatile organic compounds. Exhaust emission measurements were corrected for background ambient pollutant concentrations. Semi-volatile organic compounds, metals and sulfur dioxide emissions were not part of the scope or work for this engine. Historical aircraft engine emission sampling has noted that the semivolatile analysis have provided non-detected and scattered detected values. Metals analysis have also shown mainly non-detect values, this was confirmed by an analysis of the fuel and particulate matter. Sulfur dioxide emissions are reported based on the procedure documented by AFIERA. This procedure estimates that sulfur dioxide in the fuel undergoes complete oxidation to SO₂. The sulfur content in JP-8 fuel was determined during testing to assure consistency with published results. The emission factor for SO_2 is provided in the report.

As part of the F119-PW-100 emission testing program, samples were collected directly behind the aircraft engine, at the end of the Augmentor tube where the engine exhaust exits the hush house, and in the slipstream duct. As described in section 2 and shown in Figure 2-6, a stainless steel rake with multiple sampling nozzles was installed directly behind the engine to collect gaseous, benzene and formaldehyde emissions data at the idle and approach engine settings. Near the end of the Augmentor tube, where the emissions exhaust the hush house, a stainless steel slipstream sampling system was installed to transfer the engine exhaust out of the hush house to a safe location for sampling. The slipstream rake, shown in Figure 2-9, consists of twelve

Test Report Section 6 Revision 2 June 2002 Page 2 of 36

sample intake nozzles that were used to determine pollutant distribution in the augmentor tube and to collect a gaseous emission sample from each of the twelve points. After the slipstream had exited the hush house, the slipstream duct was utilized to extract manual samples for PM, aldehyde and ketones and volatile organic compounds. These sampling locations are referred to as the engine rake, slipstream rake and slipstream duct accordingly. The purpose of sampling at multiple locations was to study the pollutant mass emission rates as they traveled from the engine to the atmosphere and note if any secondary chemistry occurred during the residence time in the augmentor tube. The emissions data are discussed in this section.

6.1 GASEOUS POLLUTANTS

Gaseous emissions were collected at the engine rake (idle and approach settings only), slipstream rake and slipstream duct (during the shakedown runs only). The results of the sampling at each location is provided in the following sections.

6.1.1 Shakedown Runs

Prior to the actual emission test runs at each engine setting, a series of shakedown runs were performed to note gaseous pollutant concentrations, and air flows and to refine communication logistics. During the shakedown runs gaseous emissions data was collected for NO_X, CO, CO₂, O₂ and NMHC at 10% (idle), 20% (approach), 70% (intermediate), 100% (military) and 150% (afterburner) engine power at each of the 12 points on the slipstream rake. These sample results were used to determine if pollutant emission rates varied across the augmentor tube. During the shakedown runs, gaseous emissions were also collected directly behind the engine using a multi-point engine sampling rake during the 10% and 20% engine settings only. The engine rake had to be removed at the higher power settings to eliminate the potential for engine and/or hush house damage. At all power settings, gaseous emissions data was collected at the slipstream rake (which is located at the end of the augmentor tube) just

Test Report Section 6 Revision 2 June 2002 Page 3 of 36

prior to the exhaust to the atmosphere and at a downstream location in the slipstream duct.

Tables 6-1 and 6-2 present the gaseous emissions data collected at the 10% and 20% engine power settings during the shakedown runs. Ambient, engine rake (directly behind the engine), slipstream rake (near the end of the hush house) and stack (near the end of the slipstream duct) pollutant data are compared. Carbon monoxide (CO) concentrations were measured higher at the engine rake when compared to the slipstream rake, due to the reaction of ambient air with exhaust gas to convert CO to CO_2 .

Pollutant reaction from the engine to the hush house exhaust was noted in the NO_X data. NO continued to react with dilution air to form NO_2 . This can be seen in the NO/NO_2 ratio. At the 10% engine setting the NO/NO_2 ratio is 0.9 at the engine rake and 0.4 at the slipstream rake. This indicates that there is more NO_2 present in the exhaust stream near the end of the augmentor tube. This same NO_X conversion is seen at the 20% power setting.

As the engine power was increased above 20% the engine sampling rake was removed. Gaseous data collected outside the hush house (ambient), at the slipstream rake and at the slipstream duct are presented in Tables 6-3 through 6-5 for engine power settings 70%, 100% and 150%. These data sets showed strong correlation between sampling points and demonstrated the typical trend in aircraft engine emissions. The CO emissions decreased significantly above 20% power and the NO_X emissions began to increase at the 70% power setting. NMHC emissions were extremely low which is a characteristic of the low by-pass improved combustor technology.

Just prior to commencement of the shakedown campaign, a gaseous emission data collection effort was performed in an attempt to note the power setting when CO emissions decrease and NO_X emissions increase. The idle, approach, intermediate, military and afterburner settings are separated by a relatively large amount of throttle

Test Report Section 6 Revision 2 June 2002 Page 4 of 36

position and power. Table 6-6 contains the gaseous emissions data collected at the additional settings. The CO emissions begin to trend downward at 12% power with the largest decrease at the 15% power setting. Also, the NO_X emissions begin to increase above 20% power. These data are important with respect to ground idle emissions. CO emissions can be reduced by approximately 64% (by weight) by increasing the engine idle speed from 10% to approximately 15%+.

6.1.2 Gaseous Emission Factors

The emission factors for the F119-PW-100 engine are presented in Tables 6-7 and 6-8. As discussed previously in section 4 of this report, the hush house exhaust rate was determined using three methods. Carbon balance, tracer gas and F-factor methodologies were employed so that each method could be evaluated to note the most representative data set. At all settings the exhaust flow calculated by tracer gas provided the data set most comparable to historic data collected by Pratt & Whitney for the F119-PW-100. The emissions data collected were typical for engines in this class. Historic emission indexes for the F119-PW-100 engine were approximately 7.7 and 17.1 lbs/1000 lbs fuel for NO_x at idle and approach respectively. The data collected during this test program indicated NO_X emission factors of 3.0 and 6.6 lbs/1000 lbs fuel respectively. This comparable trend was noted for the remaining criteria pollutants also. At the intermediate, military and afterburner settings, tracer gas was the most representative method to determine the exhaust flow. The emissions data determined using the tracer gas flow methodology compared well with data provided by Pratt & Whitney for the F119-PW-100. At intermediate and military the CO emission factors provided by Pratt & Whitney were 0.8 and 0.7 lbs/1000 lbs fuel respectively. The data collected during this program yielded emission factors of 2.1 and 0.8 lbs/1000 lbs fuel for CO. Once again, the remaining pollutants provided similar comparisons. The NMHC results at the military and afterburner settings were non- detect since the recorded value was detected near the instrument detection level and due to correction

Test Report Section 6 Revision 2 June 2002 Page 5 of 36

of data for analyzer drift and the ambient concentration, the corrected value dropped to zero.

Table 6-8 presents the emission factors determined at the engine rake for the idle and approach engine settings. The NOx and CO emission factors at the slipstream rake and engine rake were very comparable. At idle the NOx emission factors were 3.0 lbs/1000 lbs fuel and 1.9 lbs/1000 lbs/fuel for the slipstream rake and engine rake respectively. The CO emission factors at idle were 48.2 lbs/1000 lbs fuel at the slipstream rake and 76.1 lbs/1000 lbs fuel at the engine rake. At approach, the NOX and CO emission factors at the slipstream rake were 6.6 lbs/1000 lbs fuel and 7.9 lbs/1000 lbs fuel respectively. The NOx and CO emission factors at approach at the engine rake were 5.4 lbs/1000 lbs fuel and 7.3 lbs/1000 lbs fuel. At the idle and approach settings the CO was continuing to react in the augmentor tube to form CO_2 . This was noted by a decrease in the mass of CO from the engine rake to the slipstream rake and an increase in CO_2 at the slipstream rake.

6.2 VOLATILE ORGANIC COMPOUNDS

Speciation of volatile organic compounds was performed at the hush house exhaust for each engine setting with the exception of afterburner. The highest emission rate of volatiles was at the idle setting. This has been the typical trend in historic engine emission testing. Due to the inefficiencies in engine operation at idle, unburned hydrocarbons tend to be present in the exhaust stream resulting in higher organic emissions. The VOC HAP total at idle was 0.36 lbs/1000 lbs fuel. The detected compounds at each setting were similar to the speciated HAPs determined in historical test programs. Typically, naphthalene, benzene, toluene, ethylbenzene, xylene and styrene were detected in the exhaust stream. This is the same trend noted in the exhaust stream of the F100 family of engines. A summary of the volatile emissions is provided in Tables 6-9 through 6-12.

Test Report Section 6 Revision 2 June 2002 Page 6 of 36

6.2.1 Speciated Pollutant Comparison

Samples for benzene and formaldehyde were collected directly behind the engine and at the slipstream duct to note the variation in emissions at the idle and approach settings. The benzene emissions determined directly behind the engine are summarized in Table 6-14. These data compare very well to the benzene emission at the slipstream shown in Table 6-9. At idle the emission factor for benzene behind the engine was 0.12 lbs/1000 lbs fuel and 0.11 lbs/1000 lbs fuel at the slipstream. At the approach engine setting, the benzene emission factor was 0.003 lbs/1000 lbs fuel at the slipstream and the engine exhaust. Formaldehyde samples collected at the idle and approach setting behind the engine were compared to the formaldehyde data collected at the slipstream duct. These data are presented in Tables 6-13 and 6-15. The formaldehyde data collected behind the engine, shown in Table 6-15, provided an engine emission factor of 1.29 lbs/1000 lbs fuel at idle and 0.05 lbs/1000 fuel at approach. These data are very comparable to the formaldehyde data collected at the slipstream duct, which indicated an engine emission factor of 1.00 lbs/1000 lbs fuel at idle and 0.04 lbs/1000 lbs fuel at approach. Therefore both volatile compounds and aldehydes can be considered stable during mixing in the Augmentor tube and measurements collected at the slipstream duct can be considered representative of the engine emissions.

6.3 ALDEHYDE AND KETONES

Aldehyde and ketone data was collected at the slipstream duct for the idle, approach, intermediate and military settings. These data are summarized in Table 6-13. The emission rates were highest at the idle setting, which is consistent with the data trends seen in this program. Formaldehyde was the pollutant emitted in the highest quantity at 1.00 lbs/1000 lbs fuel at idle. As the engine moved from idle to the higher engine settings the emissions decreased accordingly. Formaldehyde emissions were 0.008 lbs/1000 lbs fuel at military.

Test Report Section 6 Revision 2 June 2002 Page 7 of 36

6.4 POLLUTANT MIXING IN THE AUGMENTOR TUBE

Pollutant mixing in the Augmentor tube was examined through the use of 12 sampling points within the Augmentor tube fixed to the slipstream rake. The points were positioned according the to procedures in EPA Method 1 and are provided in Figure 6-1. By investigating the relationship between the tracer gas and emissions from the engine we could define the profile within the augmentor tube (at the point of collection, the slipstream rake) for both tracer gas mixing and engine emissions. At idle and approach CO was compared to SF_6 , CO was chosen because of relative high concentration and resolution. NO_x was selected at intermediate and military because of its high concentration and resolution. The concentrations of SF_6 varied by 9%, 5% and 4% between the highest and lowest value observed from the 12 sampling points at idle, approach and intermediate, respectively. This indicated that SF₆ was well distributed with the ambient air entering the hush house and into the augmentor tube. The variance in CO concentrations was 17% and 12%, and for NO_x, 15% between high and low with the highest concentrations in the lower and central portion of the slipstream rake at idle, approach and intermediate, respectively. This indicated that exhaust flow from the engine was more laminar and combustion gas was centered in the augmentor tube. The variance in emissions does not impact sample collection since the gaseous emissions were collected at all 12 slipstream rake intake points and averaged and the inorganic and volatile samples were collected from the slipstream duct where there was a slight increase in concentration. The data showed at the tested conditions, that stratification of the engine exhaust was not significant.

At military, SF₆ showed stratification, as there was a 14% difference between the highest and lowest value observed from the 12 sampling points. NO_X show a 20% difference with the highest concentrations observed at the lower and central portion of the slipstream rake. At the military setting, the force of the engine exhaust developed a more stratified flow structure through the augmentor tube and the hush house as well, as indicated by the degraded mixing of SF₆ with the ambient air.

Test Report Section 6 Revision 2 June 2002 Page 8 of 36

Though minimal stratification was present at all engine settings the data was not significantly biased (and if a bias exists it would generally favor higher emission rates) because for gaseous pollutants the integration of results from the 12 points was used and the inorganic and volatile samples were collected from the slipstream duct where there was a slight increase in concentration.

6.5 PARTICULATE MATTER

The total particulate emissions are presented in Tables 6-17 through 6-20. The results represent the total particulate, condensable and filterable, exiting the hush house. EQ was successful in capturing the entire particulate size range in the emission stream. A discussion of the method abnormalities is provided.

The particulate sampling methodology was improved in several ways over past sampling campaigns in order to improve the detection limit in the exhaust stream. EQ, USAF and Navy (SPAWAR SYSCEN D3621) personnel reviewed the historic sampling procedures and developed the following improvements:

- A smaller 47 mm diameter filter was used in the EPA Method 5 train. The intent was to have a lower filter tare weight and therefore have the ability to detect a small particulate gain since the gain in total weight would be a larger percentage of the filter tare weight.
- An analytical balance accurate to 5 decimal places (0.00001 grams) was used. This allowed for a more accurate gravimetric analysis since the method balance was accurate to 4 decimal places.
- The humidity of the weighing room was below 50% humidity.
- A real time particulate analyzer was used as a backup to the EPA Method 5 train to confirm particulate emission results.

The improvements made in the sampling and analytical scheme did not provide improved results. Due to the extremely low concentration of particulate matter in the engine exhaust stream, the filter gain after an extended test run with a large sample volume, was still insignificant using EPA Method 5. The EPA reference method is at or

Test Report Section 6 Revision 2 June 2002 Page 9 of 36

below the detection limit in this application. The filter fraction of the sample resulted in negative particulate gain for two reasons. The recovery procedure, per the EPA Reference Method, requires the filter sample to be removed from the support frit and associated gasket which seals the filter holder. Due to the high sample vacuum in order to meet the extended sample volume requirements, the gasket would seal to the filter and pieces of the filter remained on the gasket during sample recovery. Therefore the filter material had to be scraped from the gasket. The second reason for the low weight gain from the filter analysis was that during sample collection, following the EPA Reference Method, the filter material was removed and deposited into the impinger solution during sample collection. The heating of the filter and the large volume of sample and vacuum applied to the filter resulted in minor filter loss. This was simulated at the WESTON laboratory and confirmed that filter material was lost and deposited in the impinger solution and appeared in the inorganic faction analysis results. Since filter material appears to have been lost and recovered in the impinger solution it is not known if the filters collection efficiency was also affected. This was also seen in the particulate sample results, when the filter lost weight, there was generally a proportional increase in the inorganic fraction of the condensable particulate matter.

The total particulate matter is presented and provides the best results based on the sampling anomalies. The filterable fraction consists only of the probe rinse and the condensable fraction (organic and inorganic) consists of the particulate that passes through the probe and filter, which also contains a small portion of the filter. Therefore the total particulate (consisting of probe rinse, inorganic and organic condensable sample factions) results may be the most representative emission index accounting for a portion the loss in filter material and potential particulates that could have migrated through the filter due to the potential decrease in collection efficiency.

Particulate emission results for this engine were comparable to historic data sets. The engine also noted a similar emission trend pattern. The emission index was highest at idle 2.5 lbs/1000 lbs fuel and averaged near 1.5 lbs/1000 lbs fuel for the

Test Report Section 6 Revision 2 June 2002 Page 10 of 36

remaining settings. The variation in the data is the result of normal method variability. As a comparison, the particulate data for the F100-PW-100 engine was reviewed to note the similarities in the data sets. At idle the F100-PW-100 engine had and emission index of 2.8 lbs/1000 lbs fuel and for the test engine the factor is 2.5 lbs/1000 lbs fuel. At approach the F100-PW-100 emission factor is 1.97 lbs/1000 lbs fuel and for the test engine it is 2 lbs/1000 lbs fuel. At intermediate the emission factors were both 1.5 lbs/1000 lbs fuel for the F100-PW-100 and test engine respectively. At military the emission factors were 1.5 and 2.1 lbs/1000 lbs fuel for the F100-PW-100 and test engine respectively.

The real time particulate analyzer was unable to operate in the engine exhaust environment as set-up during this program. The vibration generated by the engine was amplified through the temporary structure the instrument was mounted on (temporary ductwork and scaffolding). This created difficulties in data collection and equipment operation as the instruments measurement principal is based on measurement of vibration. It is much more likely this method would have succeeded if the instrument would be been mounted in more stable test facility (engine test cell). The equipment failed in the field and was unable to record data. The equipment was able to collect, on an auxiliary filter, an isokinetic particulate sample for particle size distribution analysis.

6.5.1 Particle Characterization

As discussed earlier in this section, the real time particulate analyzer was used to collect an isokinetic sample for particle size analysis. The sample was collected on a silver membrane filter for analysis via scanning electron microscopy to count the particles in each size range. The results of the particle counts are provided in Table 6-18. The analysis determined that the majority of particulate matter (>97%) was below 10 microns in size with >70% of the particles at a diameter <2.5 microns. The pore size of the filter was 0.5 microns, therefore particles less than 0.5 microns in diameter may have passed through the filter. Additional analysis was performed to examine particles

Test Report Section 6 Revision 2 June 2002 Page 11 of 36

less than 0.5 microns by transmission electron microscopy (TEM) and elemental analysis of particles less than 10 microns by automated SEM.

The relatively large particles (7.5 microns and larger) were determined to be angular brittle carbon particles which most likely have been heated and cooled and deposited on a surface such as the engine tail section or hush house augmentor tube and suspended during testing and deposited on the filter. These particles are not a combustion product during emission testing but a disturbed particle. Some of the remaining relatively large particles (1 to several microns) were carbon soot agglomerates. The "bundles" of particles consisted of carbon spheres with a diameter of 0.03 to 0.05 microns. Therefore, even though the size distribution indicates particles greater than 0.5 microns in diameter, a number of the particles are groups of smaller particles in the submicron size range. It appears that the majority of the particles >2.5 microns are groups of smaller particles in the 0.03 to 0.05 microns also increases, the percentage of particles less than 2.5 microns also increases. These particles are primarily carbon soot. The submicron particles would be captured in the impinger solution of the EPA Method 5 sampling train.

The particle types consisted of silicon, sulfur and iron. There were small quantities of chrome and titanium present in select samples. There was large quantities of aluminum and silver present but these were thought to be a result of the silver membrane filter since a large quantity of these materials were verified on the filter blanks.

6.6 EXHAUST FLOW DETERMINATION

The engine exhaust flow was determined using several methods in order to provide an opportunity to review data sets and disregard outliers. Carbon balance, tracer gas and F-factor were used to determine the exhaust flow rate. The tracer gas methodology was not used to determine emissions directly behind the engine since the tracer gas could not be measured at the engine rake. The F-factor methodology tended

Test Report Section 6 Revision 2 June 2002 Page 12 of 36

to fail at oxygen concentrations greater than 18.5%. The carbon balance and tracer gas flow calculation methods provided good correlation. The tracer gas data tended to provide a better comparison with historical flow and emissions data at all settings.

6.7 FUEL ANALYSIS

Fuel samples were collected during the emission test program from the fuel line feeding the engine. The fuel was analyzed to determine the presence of select metals. In each sample, small quantities of copper, zinc and phosphorous were present. In one sample a small quantity of nickel and thallium was present. The fuel analysis results represented in Table 6-22.

6.8 ENGINE OPERATION

During the emission test program, specific engine parameters were monitored to note engine performance. Pratt & Whitney personnel were responsible for collecting and maintaining the operating data and for operating the engine in a safe manner. A summary of the engine operation is provided in Table 6-23.

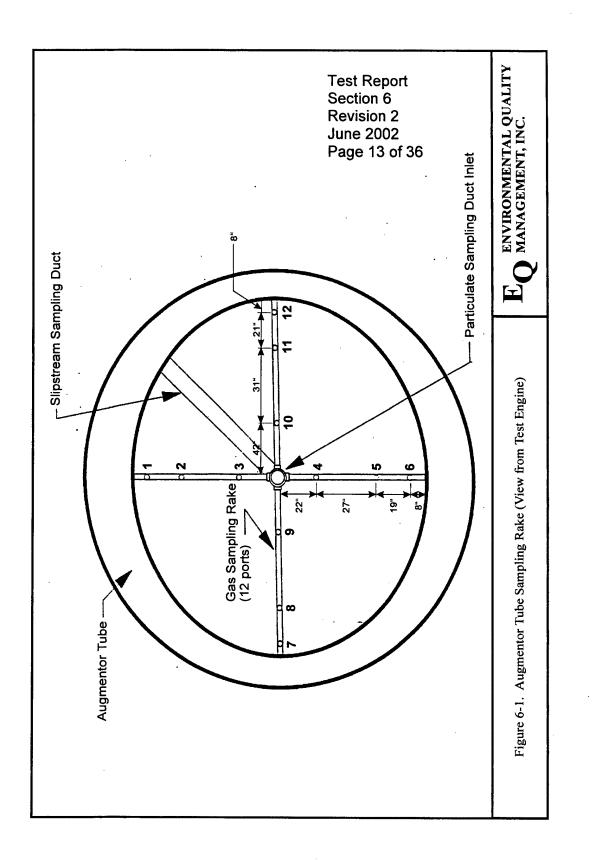


TABLE 6-1. F119-PW-100 GASEOUS EMISSIONS SUMMARY 10% POWER SETTING

Sampling Location 02	ő	High	Low	No	No,	° N	Hc	NMHC	сң	ខ	Amb.	Amb.	Virtual	Amb.
		ő	°o								F	ਮੁੱ	Ambient NMHC	ço
	dry %	dry %	dry ppm	dry ppm	dry ppm	dry ppm	dry ppm dry ppm wet ppm	wet ppm	wet ppm	dry ppm	wet ppm	wet ppm	wet ppm	wet ppm
							(as C ₃ H ₆)	(as C ₃ H ₆)	(as CH4)		(as C ₃ H ₆)	(as CH4)	(as C ₃ H ₆)	
Ambient	20.4	0.4	395	0.5	0.5	1.0	2.3	1.4	2.5	0.0	1.0	0.5	0.8	524
Engine Rake	18.4	1.6	Saturated	4.3	4.8	9.1	29.6	282	4.3	439.8	1.5	2.0	0.7	396
Slip Stream Rake	20.1	0.5	Saturated	0.5	1.4	2.0	6.1	4.9	3.5	52.6	1.0	2.1	0.3	370
Slip Stream Duct	20.2	0.5	Saturated	0.5	1.4	2.0	6.0	4.8	3.5	54.4	1.0	2.5	0.2	331
NOTE: Values entered in BOLD have been adjusted for internal cons	BOLD have b	een adjusted	for internal con	sistentcy as follows;	ollows;									ver else te
Negative values (after calibration bias correction) have been increased to zero.	bration bias c	orrection) hav	ve been increase	sd to zero.									anne Parte and Article and Art	
NMHC values have been adjusted to reflect the difference between the	idjusted to re	flect the differ	rence between ti	he THC and n	nethane value	ns for both s	ource and am	he THC and methane values for both source and ambient locations.	s.					
NO2 values have been adjusted to reflect the difference between the	usted to refle	ct the differer	nce between the	measured N	ox and NO va	lues., excel	ot when ambit	ant measurem	measured Nox and NO values. except when ambient measurements are made	6	•			
ror ampient measurements, the NU number was adjusted to reliect	IS, THE NU NL	Jmder was ac	JUSTED TO FEILECT		the difference detween the NUZ and NUX values.		VUX VAIUBS.							

Test Report Section 6 Revision 2 June 2002 Page 14 of 36 TABLE 6-2. F119-PW-100 GASEOUS EMISSIONS SUMMARY 20% POWER SETTING

n na na shekara na manan a sa a sana anan karano a sa ka na samma na panonya karan ka sana ang	CANADARY I & JANK SAMA SAMA	And a set of the set of the set of the			% N7			פ						
Sampling Location	6	High	Low	Q	N02	×on	THC	NMHC	CH₄	ខ	Amb.	Amb.	Virtual	Amb.
		Ő	Ö								C7F	'n	Ambient	Ċ
	dry %	dry %	dry ppm	dry ppm	dry ppm	dry ppm dry ppm	wet ppm	wet ppm wet ppm	wet ppm	dry ppm	wet ppm	wet ppm	wet ppm	wet ppm
								as C ₃ H ₆) (as C ₃ H ₆) (as CH ₄)	(as CH4)		(as C ₃ H ₆)	(as CH4)	(as C ₃ H ₈)	
Ambient	20.7	0.3	367	0.1	0.9	1.0	1.3	0.4	2.5	0.0	1:0	4.2	0.0	416
Engine Rake	18.5	1.8	Saturated	23.7	6.2	28.9	4.0	3.5	1.5	63.9	1.0	3.9	0.0	368
Slip Stream Rake	20.3	0.5	Saturated	2.4	1.4	3.8	1.9	1.0	2.6	7.5	1.3	3.5	0.2	375
Slip Stream Duct	20.4	0.5	Saturated	2.8	1.3	4.1	2.0	1.2	2.5	4.9	1.0	4.4	0.0	320
NOTE: Volues antered in BOI D have been adjuicted for internal access	tol D have he	on adjucted :	for internal conc	intentor on fo	letter.						•			
Negative values (after calibration bias correction) have been increased	ration bias co	irrection) have	e been increased	d to zero.										
NMHC values have been adjusted to reflect the difference between the THC and methane values for both source and ambient locations.	Jjusted to reflu	ect the differ	ance between th	e THC and m	ethane values	s for both sou	irce and amb	ient locations.						
NO2 values have been adjusted to reflect the difference between the measured Nox and NO values, except when ambient measurements are made.	isted to reflec	t the differen	ce between the	measured No	x and NO valu	ues., except	when ambier	nt measureme	nts are made					
For ambient measurements, the NO number was adjusted to reflect the difference between the NO2 and NOx values.	s, the NO nur	mber was adj	usted to reflect t	the difference	between the	NO2 and NC	1x values.							

Test Report Section 6 Revision 2 June 2002 Page 15 of 36 TABLE 6-3. F119-PW-100 GASEOUS EMISSIONS SUMMARY 70% POWER SETTING

					1 % 0 /	JOVE	DNII I I I I I I I I I I I I I I I I I I	פפ						
Sampling Location	ဝိ	High	Low	õ	NO2	*on	ЪĦС	NMHC	Ğ	ខ	Amb.	Amb.	Virtual	Amb.
		°02	OS						-		THC	ĊH	Ambient NMHC	ő
	% کم مرک	dry %	dry ppm	dry ppm	dry ppm	dry ppm	dry ppm dry ppm wet ppm wet ppm wet ppm	wet ppm	wet ppm	dry ppm	wet ppm	wet ppm	wet ppm	wet ppm
							(as C ₃ H ₆)	(as C ₃ H ₆) (as C ₃ H ₆)	(as CH4)		(as C ₃ H ₆)	(as CH4)	(as C ₃ H ₆)	
Ambient	21.5	0.2	434	0.6	0.5	1.1	1.9	6.0	3.1	15.8	1.0	4.1	0.0	565
Slip Stream Rake	20.6	0.4	Saturated	10.4	1.6	12.0	1.5	0.5	3.1	3.4	1.3	5.5	0.0	453
Slip Stream Duct	21.0	0.5	Saturated	10.6	1.7	12.3	1.5	0.5	3.1	0.5	2.0	6.1	0.0	563
NOTE: Values entered in BOLD have been adjusted for internal consistentcy as follows.	OLD have bee	an adjusted fo	r internal consi:	stentcy as foll	.swo									
Negative values (after calibration bias correction) have been increased to zero. NMHC values have heen adjingted to reflect the difference helween the THC and methane values for hold source and amhient invariance.	ation bias con listed to refle	rection) have ct the differen	been increased	to zero. THC and met	hane values	for hoth cour	re and amhie	nt Incatione	1		-	-		
NO2 values have been adjusted to reflect the difference between the	sted to reflect	the difference	3 between the n	neasured Nox	and NO value	3S., except v	measured Nox and NO values except when ambient measurements are made	measuremen	ts are made.				• • • • • • • • • • • • • • • • • • • •	
For ambient measurements, the NO number was adjusted to reflect	, the NO num	iber was adjus	sted to reflect th	the difference between the NO2 and NOx values.	etween the N	IO2 and NO1	k values.				- Caller - Market Coleman - Market	The second stress of the secon	And it is a substantiation of a substantial of the	anna ann anna ann ann ann ann ann ann a
				THE PARTY AND A PA		VALUE A MARKET OF FAMILY A REAL OF		A MANUAL OF A PARTY OF	A NUMBER OF A DESCRIPTION OF A DESCRIPTIONO OF A DESCRIPTIONO OF A DESCRIPTIONO OF A DESCRIPTIONO OF A DESCR	THE TAXABLE TAXABLE TAXABLE TAXABLE TAXABLE TAXABLE TAXABLE	and the set of the set			

Test Report Section 6 Revision 2 June 2002 Page 16 of 36 TABLE 6-4. F119-PW-100 GASEOUS EMISSIONS SUMMARY 100% POWER SETTING

τι το πιστροφοριστικό Manufalamenta στα της τος τοριστικός μα		A REAL PROPERTY OF A REAL PROPER			%00L	П Х С Х П	DO% POWER SETTING	כי						
Sampling Location	õ	High	Low	Q.	NO2	No.	тнс	NMHC	сӉ	ខ	Amb.	Amb.	Virtual	Amb.
		°0 C	ő								THC	CH,	Ambient NMHC	ပိ
	dry %	dry %	dry ppm	dry ppm	dry ppm	dry ppm	dry ppm dry ppm wet ppm wet ppm	wet ppm	wet ppm	dry ppm	wet ppm	wet ppm	wet ppm	wet ppm
			(Ambient)				(as C ₃ H ₆)	(as C ₃ H ₆) (as C ₃ H ₆) (as CH ₄)	(as CH4)		(as C ₃ H ₈)		(as C ₃ H ₈)	
Ambient	31 N	01	338	0.0	00		51	ΥU	ле С	00	0.6	ΛE	N C	EOC
	2		222	7.0	0.0		<i>S</i> .	1	×.0	2.2	z.U	4.0	0.0	200
Slip Stream Rake	20.2	0.6	333	33.9	1.4	35.3	0.0	0.4	1.7	2.2	1.3	2.3	0.6	544
Slips Stream Duct	20.1	0.6	334	35.8	1.7	37.6	1.3	0.4	2.6	0.0	1.0	1.0	0.7	483
NOTE: Values entered in BOLD have been adjusted for internal consistentcy as follows:	OLD have be	en adiusted fr	or internal consi	stentov as fo	lows:									
Negative values (after calibration bias correction) have been increased	ation bias co	rrection) have	been increased	d to zero.										
NMHC values have been adjusted to reflect the difference between the	justed to refl	ect the differe	nce between the	e THC and m	sthane values	for both sou	THC and methane values for both source and ambient locations.	ent locations.						
NO2 values have been adjusted to reflect the difference between the measured Nox and NO values, except when ambient measurements are made.	sted to reflec	t the differenc	e between the r	measured No.	x and NO valu	Jes., except	when ambient	t measureme	nts are made.					
For ambient measurements, the NO number was adjusted to reflect the	, the NO nur	nber was adju	isted to reflect to	he difference	he difference between the NO2 and NOx values.	NO2 and NC	1x values.							

Test Report Section 6 Revision 2 June 2002 Page 17 of 36 TABLE 6-5. F119-PW-100 GASEOUS EMISSIONS SUMMARY 150% POWER SETTING

A R AR R INNER WAY - A 14 M MULTING A 14 M MULTING A 14 M MULTING A 144 M MULTING A			A ST)))) : : :						
Sampling Location	്	High	Low	Ŷ	NO2	NO [*]	THC	NMHC	СН <mark>,</mark>	ខ	Amb.	Amb.	Virtual	Amb.
		ç	co,				1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Nonderson Real Vision of a sub-sub-supervised	-	THC	CH	Ambient NMHC	රු
	dry %	dry %	dry ppm	dry ppm	dry ppm	dry ppm	wet ppm	dry ppm dry ppm wet ppm wet ppm wet ppm	wet ppm	dry ppm	wet ppm	wet ppm	wet ppm	wet ppm
			(Ambient)				(as C ₃ H ₆)	(as C ₃ H ₆) (as C ₃ H ₆) (as CH ₄)	(as CH4)		(as C ₃ H ₆)	(as CH4)	(as C ₃ H ₈)	
Ambient	21.0	0.1	321	02	0.9	1.1	0.6	0.0	2.6	0.0	1.0	2.0	0.3	360
Slip Stream Duct	18.9	1.4	326	0.0	7.7	35.4	0.6	0.0	1.5	127.3	1.0	2.0	0.3	552
NOTE: Values entered in BOLD have been adjusted for internal consistentcy as follows;	30LD have be	sen adjusted t	for internal cons	istentcy as fo	illows;									1
legative values (after calibration bias correction) have been increased to	ration bias cc	prrection) have	e been increase.	d to zero.							-			
IMHC values have been adjusted to reflect the difference between the	djusted to refl	lect the differe	ence between th	e THC and m	ethane values	s for both so	urce and amb	IHC and methane values for both source and ambient locations.						
NO2 values have been adjusted to reflect the difference between the measured Nox and NO values. except when ambient measurements are made.	isted to reflec	ot the different	ce between the	measured No	x and NO vali	ues., except	when ambier	nt measureme	nts are made.				1	
For ambient measurements, the NO number was adjusted to reflect the	s, the NO nut	mber was adj	justed to reflect t	the difference	difference between the NO2 and NOx values.	NO2 and NC	Ox values.							
		· · · · · · · · · · · · · · · · · · ·	for the two of second many second					dar manual and a survey				*	4	and a strong

Test Report Section 6 Revision 2 June 2002 Page 18 of 36

TABLE 6-6. F119-PW-100 GASEOUS EMISSIONS SUMMARY VARIOUS POWER SETTINGS SLIPSTREAM RAKE

Power Setting	õ	High	Low	9	°ov	° v	THC	NMHC	Ť	ខ	Amb.	Amb.	Virtual	Amb.
		ç	. co2								THC	CH	Ambient NMHC	ဝိ
	dry %	dry %	dry ppm	dry ppm	dry ppm	dry ppm	wet ppm	wet ppm	wet ppm	dry ppm	wet ppm	wet ppm	wet ppm	wet ppm
							(as C ₃ H ₆)	(as C ₃ H ₆)	(as CH4)		(as C ₃ H ₆)	(as CH4)	(as C ₃ H ₈)	
10%	20.6	0.5	Saturated	0.0	2.0	2.0	12.0	10.7	3.9	59.0	2.3	5.6	0.4	348
12%	20.6	0.5	Saturated	0.0	2.0	2.0	5.4	4.1	3.9	35.6	2.3	4.5	0.7	451
15%	20.6	0.5	Saturated	0.5	2.4	2.9	3.6	2.3	3.9	21.4	2.3	5.6	0.4	410
20%	20.6	0.5	Saturated	1.6	2.4	3.9	1.8	0.6	3.9	4.6	1.9	4.0	0.5	475
65%	20.4	0.7	Saturated	<u>9</u> .8	2.4	12.2	1.8	0.5	3.9	0.0	2.3	4.5	0.7	469
70%	20.4	0.7	Saturated	11.9	2.3	14.2	1.8	0.8	2.9	0.0	1.9	4.5	0.4	324
80%	20.3	0.8	Saturated	17.1	2.4	19.5	1.8	0.8	2.9	0.0	2.3	4.0	0.9	416
100%	20.3	0.9	Saturated	38.9	22	41.0	1.8	0.8	2.9	0.0	1.9	4.5	0.4	317
150%	19.1	1.5	Saturated	32.6	6.5	39.1	11.4	10.4	2.9	87.5	2.3	4.5	0.7	390
NOTE: Values entered in 801.0 have heen adjusted for internal consistenticy as follows:	ROI D bave he	en adincted f	for internal cons	ctentry as fo	lowe.									
Vegative values (after calibration bias correction) have been increased to	pration bias col	rrection) have	been increased	l to zero.	12112									
VMHC values have been adjusted to reflect the difference between the 1	idjusted to refle	ect the differe	ince between the		ethane values	for both sou	irce and amb	HC and methane values for both source and ambient locations.						
NO2 values have been adjusted to reflect the difference between the measured Nox and NO values., except when ambient measurements are made	usted to reflect	t the differenc	ce between the r	neasured No.	(and NO valu	les., except	when ambier	t measureme	nts are made					
⁻ or ambient measurements, the NO number was adjusted to reflect the	ts, the NO nun	nber was adju	usted to reflect t		difference between the NO2 and NOx values	NO2 and NC	1x values.							
All data collected at the slipstream rake.	lipstream rake.		~ ~ ~	~ .										

Test Report Section 6 Revision 2 June 2002 Page 19 of 36

TABLE 6-7. F119-PW-100 SLIPSTREAM RAKE EMISSION FACTOR SUMMARY

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anna MMA Mar Sharka a ba ca 100 a a shaman a ca a mar a a canna nga a a san an an							Engln	Engine Mode								
		Idie			Approach			Intermediate	9		Military			Afterburner	18	
Flow Rate, dscfm		209029			283 2 83			1458213			1823426			1832439		Γ
			lbs/1,000			lbs/1,000			lbs/1,000			lbs/1,000			lbs/1,000	ſ
Analyte	pprmvd	lb/hr	lbs fuel	pprmvd	lb/hr	lbs fuel	ppmdd	lb/hr	ibs fuel	ppmdd	lb/hr	lbs fuel	pprmd	lb/hr	lbs fuel	
Nitrogen Oxide (NO)	0.5	0.68	0.49	2.4	7.44	2.72	10.4	70.86	10.7	33.9	230.98	12.41	0.82	190.78	3.80 3.80	Γ
Nitrogen Dioxide (NO ₂)	1.4	2.90	2.11	1.4	<u>6.66</u>	2.43	1.6	16.71	1.65	1.1	14.63	0.79	2.7	80.44	1.80	
Nitrogen Oxides (NO _X)	2	4.14	3.01	3.8	18.06	6.59	12.0	125.36	12.40	36.3	368.76	19.81	35.4	369.60	7.37	Γ
Carbon Monoxide (CO)	52.6	66.30	48.15	7.5	21.71	7.92	₽'E	21.62	2.14	2.2	13.99	0.75	127.0	807.67	16.10	Γ
Net NMHC (as C ₃ Hg)	4.6	9.41	6.83	0.2	0.94	0.34	0.5	5.35	0.53	0.0	00:0	N 00:0	ND 0.7	9.27	0.18	g
Carbon Dioxide (CO ₂), a	0.5	4662	3386	0.5	2962	3426	0.4	36208	3681	0.6	54312	2918	4.1	126728	2526	
Sulfur Dioxide (SO ₂)	¥	0.52	0.38	₹	1.04	0.36	٩N	3.84	0.38	M	7.07	86.0	¥	19.06	0.38	
														· · · · · · · · · · · · · · · · · · ·		
NU - Value represents method detection limit. Compound may be present	i limit. Compou	nd may be pres	sent at a value l	at a value less than the detection limit	stection limit.											
NA - SO2 rates determined from fuel sulfur content.	fur content.															
a - CO ₂ data based on carbon balance flow determination.	ow determinatio	Ĺ.												-		
and the second			àn a manair				x	í	······································			Contraction of the second			AT TRADUCTION AND A TO MINIMUM TRADUCTION	

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(Flow By Tracer)

Test Report Section 6 Revision 2 June 2002 Page 20 of 36 TABLE 6-8. F119-PW-100 ENGINE RAKE EMISSIONS FACTOR SUMMARY (Flow By Carbon Balance)

			•			
			Engine Mode	Mode		
		Idle			Approach	
Flow Rate, dscfm		39648			71637	
			lbs/1,000			lbs/1,000
Analyte	phmvda	lb/hr	lbs fuel	ppmvda	lb/hr	lbs fuel
Nitrogen Oxide (NO)	4.3	0.80	0.58	23.7	7.93	2.90
Nitrogen Dioxide (NO ₂)	4.8	1.36	0.99	5.2	2.67	0.97
Nitrogen Oxides (NO _x)	9.1	2.58	1.88	28.9	14.83	5.41
Carbon Monoxide (CO)	439.8	76.05	55.23	63.9	19.96	7.29
Net NMHC (as C ₃ H ₈)	27.5	7.60	5.52	3.50	1.75	0.64
Carbon Dioxide (CO ₂)	1.6	4347	3157	1.8	8836	3225
Sulfur Dioxide (SO ₂)	NA	0.26	0.19	NA	0.52	0.19
a = ppm by volume, dry						
NA = Emissions determined by fuel sulfur content.	ur content.					
Note: Engine Rake was used only at the Idle and Approach conditions.	Idle and App	roach condit	ons.			

Test Report Section 6 Revision 2 June 2002 Page 21 of 36

VOLATILE ORGANIC COMPOUNDS (VOCs) **EMISSIONS FACTOR SUMMARY** Idle (Flow by Tracer) TABLE 6-9. F119-PW-100

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3.12-00 5.86-00 0 6.76-00 0 <th0< th=""> 0</th0<>			1799-04					1	Automa and		0000	1	-	the after of
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3.17.00 5.36.42 7.36.45 7.36.45 7.36.45 9.1 1.15.70 5.36.42 1.06.43 4.76.42 0 0 1.15.70 5.36.42 1.06.43 4.76.42 0 0 1.15.70 5.36.42 1.36.54 4.76.42 0 0 0 1.15.70 5.36.42 1.36.54 4.76.42 0			175-03 8-05-04 1-05-01			3								₽
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5.88.6 5.88.6 1.88.2 0.88.2 0.88.2 0.88.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.99.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.98.2 0.99.2<		51260				1 808-04				10.925.3		1	L	5
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uch an element van enseme en ander ensementen neet van element van enseme en ander ensementen 18 steader constanten de ensemente oparte presenten and ensementen element. De expende quarte consecterata wen con neu 18 steader ensemente anne ensemente oparte presenten and epocarda en elemente. De expende quarte consecterata wen con neu. 18 steader ensemente anne ensemente oparte presenten and epocarda en elemente. De expende quarte consecterata wen con neu. 18 steader ensemente anne ensemente oparte presenten and epocarda en expende antenna presenten and may ca reportent 18 steader ensemente anne ensemente oparte presente ander de expende antenna presente de expende quarte consecterata and may ca reportent 18 steader ensemente anten elementen en expende antenna prese construction antenna ensemente 18 steader ensemente antenna ensemente ensemente antenna bres ensemente antenna ensemente 18 steader ensemente antenna ensemente ensementen ensemente antenna ensemente	on position and the factorial at the secret share of the factor of the second and the factorial factor and the factorial at the second and the second at the	I ITERATINE & A VALUE HENNA UNDER	CHI COLLAND ONE		the second s	÷					-			
κατό τραίη στολι απός (κον εταγρά φατάγραταρ μοτοριάτας τουν). • εκτοιτά απός το αναικό κατά ματό ματό ματό αναλατία το παλολη Μακακα, Πα σφοτά φατά ματό το αναι • κατά μαι το πό ακτοι όλου το νεγολά εατόμα φατά ματά το ματό γρατικό. Πα σφοτά φατά ματά το αναικά • κατά μαι ότα άλοιτοι όλου το νεγολά εατόμα φατά ματά ματόμα. Παι το τη οράλη στά ματά το αναικά ματά ματά το α • κατά ματά ματά ματά ματά ματά ματόμα ματά ματά ματά ματά το παλολη Μακακα. Πα σφοτά φατά ματά το αναικά	stufte are estimated, value reported is outside linear werking range													
α το εκτοκεία τοπό την ανεπικό φαναή δενούρωση την πρότες ενατικατική το την πολια το πολιατική την παρατική τη Τα ανάχει την αιδιαμεία φαναί φαναή φαναίαται παί φαρατηκατική την πολια το πολια εναία εκατία την ποριστάμι κα Τα ανάχει την αιδιαμεία φαναί την αγιατή ποιτοι την ανάχει την μαγάλη την αριάτη ότα την μοτική την αριάτη τη π	arrands quality control limits (An or ample of this is the % spine re	(have boy must and have be	-					•						
αι ανείνει το του κατά ποι το ποραιαι που το το πρόχρια ποι του προτεκό του ποραγία το ποραίο του το πορατιστία Νο κιτά βατοράζου κατά το κατά θα διατό το ποραγία θα το πόρα θα το ποραβά το το ποραίο το το πορατιστία του πορ Νο παρία ποά πλάκο ανάσε ποημά βάλ βιαλιτούν καί μοι ποράφιασμαι ζατάφια το ποραγία το εκτοποιούν.	e associated remements visible is en estemated quantity because the The statistic contained at the statistic statistic contains	e reported concertizions we		Parend detection is	mes er guality control cr	ALL THE PLAN PLAN								
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	in a start in the function of a first and a start water to be a start of the start	at at allow the ansatul la	Hanna - Hanna -	the te the dense	counte not being met									
	- the surface market there and a surface particle mark show whin the fit	UNC . MORA ADDRESS FULL SALL		Inter Daughtering of	ACE SHE OF CRIMPHUM	-								

Test Report Section 6 Revision 2 June 2002 Page 22 of 36

orbaust surger

Resouts reported as 0.00 indicate a detected activitient pol Name: Compounds analyzed in this political group are a

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TABLE 6-10. F119-PW-100 EMISSIONS FACTOR SUMMARY VOLATILE ORGANIC COMPOUNDS (VOCs) Approach (Flow by Tracer)

					,	•		·							
							Run	Run Number							
Flow Rate, dscfm			ď	663682			đ	663680				cuocasi			
		Ψ q		Iberi 000 Ibe fuel	ibs fuel			lbu/1 2000, theil	the fuel	4	b/hr	Iba/1 000 lbs fue	bs fuel	M	
Analytu	CAS Number	Detected	Detection	Detected	Detection	Delarted	Detection		Detection	1	Detection		Detection		Ibs/1 000 lbs
Chloromethane ^H	74.87-3	0.000		0.00E+00		0.00E+00		0.00F+00					-		0.000
Vinyl Chloride H	1-10-52		1.27E-03		4 61E-04 : NO		1 505-03		5 45E-04 ND	⊢	1 30F-03		A ZAF-DA ND	╇	Ş
Bromomethane ^H	24.63.9		6.33E-03		I 1		7.49E-03		E.		6515-03			g	G.
Chloroethane "	2500.3		1.27E-03		461E-04 ND		1.50E-03		5.45E-04 ND		1.30E-03			I	Ð
Fraon 11 (Inchlorofluoromethane)	75-69-4	1625-03		5 696-04		B.15E-03		2 <i>91</i> E-03		3.476-03		1.266-00		H	1.61E-03
L'T-Dichlorgethene	19:31		1.27E-03		4.61E-04 ND		1.50E.03		5.45E-04 ND		1.30E-03		4.74E-04 ND	QN	QN
Methylene Chloride	75-09-2	00000		0.00E+00		0.00E+00		0.00E+00		0.00E+00		0.00E+00		0.005+000	0.00E+00
1,1-Urchioroathana	15-34-3		1.27E-03		4 61E-04 ND		1.50E-03		5.45E-04 ND		1.30E-03				QN
Chlorotarm	67-66-3		1.27E-03	ĺ			1 50E-03		5.45E-04 ND		1.305-03		4.74E-04 ND	_	Q
1,1,1 Trichloroethane	21:55.6		1.27E-03		4 61 E-04 ND		1505-03		5.45E-04 ND		1.30E-03		4.74E-04 ND		ę
Carbon intrachionde	56-23-5	1 CME-03		3.78E-04	7	_		4.91E-04	-	B.34E-04		3 DAE-DA	7	1.07E-03	3.91E-04
Henzene "	71-43-2	8 36E-03		304E-03	-1	1.12E-02		4.095-03		7.62E-03		2 B6E-03		9 13E-03	3.33E-03
1 2-Dichloroalhane	107-06-2		1.27E-03			-	1.905.03		5.45E-04 ND		1 30E-03			QN	ON
Trichloroethene "	79-01-6	•••	1.276-03				1.505,03				1.30E-03				Q
1 2-Dichlaropropene	78-87-5		1.27E-03		461E-04 ND		1.505-03		5.45E-04 ND		1.30E-03		4.74E-04 ND		Ŷ
Irana-1,3-Dichloropropene	10061-02-6		1.27E-03		4 61E-04 ND		1 505-03		5.45E-04 ND		1.30E-03		4.74E-DN ND		Q
Toluene	108-69-3	B.11E-04		2 96E-04	- 1	1.39E-03		5 07E-04		0.00E+00		0.00E+00		7.36E-04	2 68E-04
cis-1,3-Dichloropropene	10061-01-5		1.276-03		4 61E-04 ND		1.505-03		5.45E-04 ND		1.30E-03		4.74E-04 ND	Q	9
1,1.2-Trichlomethane ^H	79.005		1.27E-03				1.50E-03		5.45E-04 : ND		1.30E-03		4.74E-04 ND		9
Tetrachiomethene H	127-18-4		1.27E-03			1.09E.03		3.986-04	-		1.30E-03			-	4.45E.04
Chlorobenzene H	108-90-7		1.27E-03		4 61E-04 ND		1 50E-03		5.45E-04 ND		1.30E-03		4.74E-04 ND	QN	Ŷ
Ethyl Benzens H	100-41-4	6.96E-04		2.54E-04	Г.		1.50E-03		5.45E-04 ND		1.30E-03		4.74E-04 ND	1.17E-03	4.24E-04
m.p-Xylene ^H	108-38-3	1.66E-03		5.99E-04		1.655-03		6.00E-04		1.30E-03		4.74E-04		1.536-03	5.586-04
o-Xylene H	96-47-6	1.01E-03		3 696-04	ſ:	9.13E-04		3 33E-04	ſ	7.17E-04		2615-04	7	8 81 E-04	3.21E-04
Styrene	100-42-5	6 96E-04		2 54E-04	-		1505-03		5.45E-04 ND		1 30E CO		4.74E-04 ND	1 17E-03	4.24E-04
1,1,2,2.Tetrachloroethane ^H	79-34-5		1.27E-03		4.61E-04 ND		1.50E-03		5.45E-04 ND		1.30E-03		4,74E-DA ND		Q
Acetone	67-64-1	0000-400		0.00E+00	P	0 OCE+C0		0.00E+00	-	0.00E+000		0.00E+00	-	0 00E+00	0.00E+00
Carbon Disulfide #	75-15-0		1.27E-03		1		1 505-03		5.45E-04 ND		1.30E.03		4.74E-04 ND	Q	Q
trans-1,2-Dichlomethene	156-60-5		1.27E-03				1.50E-03				1.30E-03				Q
Viny! Acetale 7	108-05-4		6.33E-03		2.30E-03 U		7.495-03		2.73E-03 W	4	6.51E-03		2.37E-03 W	-	£
2-Butanone (MEK)	78-50-3	843000		0 DDE +00	1	00F=00		0.000-1000	æ	0.00E+00		0.00E+00	œ	ĕ	0 COE+OD
Bromodichloromethane	12-51		1.2/E-03				1.505.03		~		1.306.03		- 1		Q
4-Methy-2-pentanone (MIBK) "	101-101		6.33E-09		2.30E-03 W		7.496.03		273E-03 W		6.51E-03		2.37E-03 W		ę
Dihromochloromethage (Chlomodihromomethage)	1.91.101		1 775.00						2./3E-US NU		6515-03			24	29
Romotom H	76.36.2		1 275.00				-		-T.		200				
cis-1 2-Dichlaroethene	156-59-2		1 275-03		AGIE-DA ND				S AFF-ILL ND		105.0		A 74F-04 ND	2	Ē
1 3-Butadiene H	106-99-0		6.336-03		1		7.496-03				651E-03		1	L	2
HAP Tetal		1,435.42		5.19E-03		1.76E-02		6.42E-03		1.07E-02		3.095-03		7	6.16E-03
ND - Compound not detected at this detection fund. Compound meat be 5 - Compound present in the aboundation blank grant han reporting fund 5 - Beaulty as a command, while anomald is an anomal of the second sec	Compound may b or then reporting ün	Compound may be present at a value less than the detection limit. . then reporting limit.	tve less than t	he detection km											
0 - Exceeds quality control limits. (An example of th	of this is the K spike recovery limit was not met.)	recovery limit was	rot met.)												
 Ine associated numerical value is an estimated q (LLI - The analyte was not disperied above the renote.) 	de duranty destaus the Roborde concentrations way set in the required defection limits of quality conflict criteria wars not met the discontine numerication limit for motion (imit for the analysical institution) and an under an analysical m	ne reported conce	Intrations were	netter (nan the n	Harried detection	imes or quality c	control criteria w	are not met							
	occurately and precisely measure for enables in the sample. This is due to the quality criteria not being met	ely measure the a	natyte in the s	temple. This is	due to the quality	critene not being	g met.		inder vom Gemme in G						
bb - The sample media blank and/or sample field bla H - This communitie listed as a hazardone air collin	blank value with two ti lineare 044Ph	times the sample	value. Sampli	e result should be consider		ed suspect due to contamination	amination.								
			•	:	``		•			:				, , ,,	:
Results reported as 0.00 indicate a detected ambient pollutant concentration greater than the detected pollutant concentration in the exhaust stream.	nt pollutant concent	tration greater tha	n the detected	pollutari conce	Intration in the ex	haust stream.			 	: : :		: : :		-	-
Note: Compounds analyzed in this pollutent group are a standard compound to	are a standard rom	nonund tamet list for the	for the analytic	nativical method and are not n	in and necession	w nombuelling he	in and a final in the	his series	••••						-

Test Report Section 6 Revision 2 June 2002 Page 23 of 36

Test Report Section 6 Revision 2 June 2002 Page 24 of 36

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TABLE 6-11. F119-PW-100 EMISSIONS FACTOR SUMMARY VOLATILE ORGANIC COMPOUNDS (VOCs) Intermediate (Flow by Tracer)

Contraction Direction Direction <thdirection< th=""> <thdirection< th=""> <t< th=""><th>Flow Rate, dscfm</th><th>-</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<></thdirection<></thdirection<>	Flow Rate, dscfm	-												
Ideal Directorial Directorial <thdirectorial< th=""> <thd< th=""><th>Flow Rate, dscfm</th><th></th><th></th><th></th><th>-</th><th></th><th></th><th></th><th></th><th>2</th><th></th><th></th><th></th><th></th></thd<></thdirectorial<>	Flow Rate, dscfm				-					2				
Ibertation (betrained) Ibertation (betrained) <thibertationed)< th=""> 1</thibertationed)<>					58213				7	(58213			Aver	olis
Defection 0.00E-00 Lmmt 1.36E:04 Dmmt 0.00E-00 Lmmt 2.78E:04 Dmmt 0.00E-00 0.00E-00 2.78E:04 N0 N0 N0 1.17E:04 2.78E:04 N0 N0 N0 0.00E-00 1.38E:03 N0 N0 N0 1.38E:04 </th <th></th> <th></th> <th>A</th> <th></th> <th>1900 (vad)</th> <th>lbs fuel</th> <th>L</th> <th>the the</th> <th></th> <th>1bert 200</th> <th>) Ibs fuel</th> <th></th> <th></th> <th></th>			A		1900 (vad)	lbs fuel	L	the the		1bert 200) Ibs fuel			
0.00E +00 2.75E.04 N0 000E +00 0.00E +00 2.75E.04 N0 N0 1.75E.04 2.75E.04 N0 N0 2.75E.04 N0 N0 N0 2.75E.04 N0 N0 N0 0.00E +00 2.75E.04 N0 N0 1.38E.03	Analyte	CAS Number	Detected	Detection	Detected	Detection	č		Detection	Detected	Detection		ž	191000 (June) Janih
276E.04 NO NO 0.00E+00 278E.04 NO NO 0.00E+00 278E.04 NO NO 0.00E+00 278E.04 NO NO 0.00E+00 278E.04 NO NOE 0.00E+00 278E.04 NO NO 0.00E+00 278E.04 NO NO 1.76E.01 278E.04 NO NO 2.578E.04 NO NO NO 0.00E+00 2.78E.04 NO	Chloromethane H	74-87-3	0.00E+00		0001-000		6	00+90		0.00E+00			0.00E+00	0.00E+00
138Ecg NO NO NO 0.00E-00 2.78E-04 NO 0.006 0.00E-00 2.78E-04 NO 0.006 0.00E-00 2.78E-04 NO 0.006 0.00E-00 2.78E-04 NO 0.006 0.00E-00 2.78E-04 NO NO 0.176E-04 NO NO 2.97E-04 1.17E-04 2.78E-04 NO NO 2.78E-04 NO NO 0.006 2.78E-04 NO NO 0.006 2.78E-04 NO NO 0.006 0.00E-00 2.78E-04 NO NO 0.00E-00 2.7	Vinyl Chloride ^H	75-01-4		2.45E-03		t	g		2.79E-03		2.76E.04	2	2	2
0.00E-60 2.78E-04 ND 0.00E-00 0.00E-60 2.78E-04 ND ND 0.00E-00 1.05E-06 2.78E-04 ND ND 0.00E-00 2.78E-04 ND ND 0.00E-00 2.78E-04 ND 2.78E-04 ND ND 2.78E-04 ND ND 2.78E-04 ND ND 0.00E-00 2.78E-04 ND ND 2.78E-04 ND ND 0.00E-00 2.78E-04 ND ND 2.78E-04 ND ND 0.00E-00 2.78E-04 ND ND 0.00E-00 2.78E-04 ND ND 0.00E-00 2.78E-04 ND ND	Bromomethane ^H	74-83-9		1.23E-02			R		1.39E-02		1.305-03	Q	Q	2
0.006-00 276E-04 N0 0.006-00 0.006-00 276E-04 N0 0.006-00 0.006-00 276E-04 N0 0.006-00 0.51E-04 N0 0.006-00 276E-04 1.17E-04 2.57E-04 N0 N0 2.57E-04 N0 N0 0.006-00 0.006-00 2.75E-04 N0 N0 1.38E	Chloroethane ^H	75-00-3		2.45E-03			_	••	2.79E-03		2.76E-04	£	Q	Ŷ
0.00E+00 2.78E-04 N0 N0 0.176E-04 2.78E-04 N 1006-00 2.78E-04 N 1006-00 2.276E-04 2.78E-04 N 0 0.006-00 2.78E-04 N 0 0.006-00 2.78E-04 N N 0 0.006-00 2.78E-04 N N 0.006-00 2.78E-04 N N 2.78E-04 N N N 2.78E-04 N N N 2.78E-04 N N N 2.78E-04 N N N 0.006-00 2.78E-04 N N	Freen 11 (Trichlorofluoromethane)	12-69-1	0.00E+00		00+300:0		_	8		0.00E+00			0.00E+00	0.00E+00
279E-03 0.00E-400 278E-04 10 0.00E-400 279E-03 B-54E-64 278E-04 1 1.88E-63 279E-03 2.78E-04 1 1.88E-63 2 279E-03 2.78E-04 1 1.88E-63 1 279E-03 2.78E-04 NO 0 0 279E-03 2.78E-04 NO NO 0 279E-03 2.78E-04 NO NO 0 279E-03 2.78E-04 NO NO NO 279E-03 0.00E-00 2.78E-04 NO NO 279E	1,1-Dichloroethene	75-35-4		2.45E-03		- T	4		2.79E-03		2.76E-04	g	Q	2
B.SteEod 2.78E-04 ND ND 2.77EE-04 ND ND 2.97EE-03 7.17EE-01 2.78E-04 ND ND 7.17EE-01 2.78E-04 ND ND 7.17EE-01 2.78E-04 ND ND 7.17EE-01 2.78E-04 ND ND 7.07EE-01 ND ND 0 7.07EE-01 ND ND 0 7.78EE-04 ND ND 0 7.78EE-04 ND ND 0 7.78EE-04 ND ND 0 6.02E-01 2.78EE-04 ND ND 6.02E-04 2.78EE-04 ND ND 0.00E+00 2.78EE-04 ND ND 0.00E+00 2.78EE-04 ND ND 1.38E-03 ND ND ND 0.00E+00 2.78EE-04 ND ND 1.38E-03 ND ND ND 1.38E-03 ND ND	Mathylane Chloride	75-09-2	0.06+00		0.00E+00	÷ 1	_			0.00E+00			0.00E+00	0.00E+00
B.Ster.GS J.T68C-GI J. J.085C-GI 2.776E-GV 2.776E-GV NO 2.776E-GI 7.176E-GV 2.776E-GV NO 2.776E-GI 7.176E-GV 2.776E-GV NO 0 7.176E-GV 2.776E-GV NO NO 7.176E-GV 2.776E-GV NO NO 7.776E-GV NO NO NO 7.776E-GV NO NO NO 7.776E-GV NO NO 0 7.776E-GV NO NO NO 7.776E-GV NO NO	1,1-Dichloroethane H	75-34.3		2.45E-03					2 79E-03		2.76E-04	g	QN	g
2.78E-GL 2.78E-GL ND ND 7.17E-GL 2.78E-GL ND ND 7.17E-GL 2.78E-GL ND ND 2.78E-GL ND ND ND 0.00E-GD 2.78E-GL ND ND 0.00E-GD 2.78E-GL ND ND 0.00E-GD 2.78E-GL ND ND 0.00E-GD 2.78E-GL ND ND 1.38E-GS ND ND ND <tr< td=""><td>Chloroform ^H</td><td>67-66-3</td><td></td><td>2.45E-03</td><td></td><td></td><td>_</td><td>BAE-OA</td><td></td><td>B.54E-06</td><td></td><td>-</td><td>1.665-03</td><td>1.BIE-OI</td></tr<>	Chloroform ^H	67-66-3		2.45E-03			_	BAE-OA		B.54E-06		-	1.665-03	1.BIE-OI
2.776-04 2.976-04 2.976-04 7.176-04 2.786-04 N0 N0 2.786-04 N0 N0 N0 0.006-00 2.786-04 N0 N0 1.386-03 N0 N0 N0	1,1,1-Trichloroethane ^H	71-55-6		2.45E-03			_		2 79E-03		2 76E-04	g	ę	9
7.17EGM 5.34E-03 6.34E-03 2.78E-04 NO NO 2.78E-04 NO NO 0.00E-00 2.78E-04 NO NO 0.00E-00 2.78E-04 NO NO 2.78E-04 NO NO NO 0.00E-00 2.78E-04 NO NO 2.78E-04 NO NO 2.78E-04 2.78E-04 NO NO 0.00E-00 2.78E-04 NO NO 0.00E-00 2.78E-04 NO NO 0.00E-00 0.00E-00 2.78E-04 NO NO 0.00E-00 2.78E-04 NO NO 0.00E-00 2.78E-04 NO NO 0.00E-00 1.38E-03 NO NO 0.00E-00 1.38E-03 NO NO 1.38E-03 NO NO 2.78E-04 1.38E-03 NO NO NO 2.78E-04 NO NO 1.38E-03	Carbon Tetrachloride ^H	56-23-5	2.36E-03		2.336-04		2	79E-03		2.76E-04			2.57E-03	2.54E-04
278E-04 ND ND 278E-04 ND ND 1000E+00 278E-04 ND ND 278E-04 ND ND ND 0.00E+00 278E-04 ND ND 0.00E+00 278E-04 ND ND 0.00E+00 278E-04 ND ND 0.00E+00 278E-04 ND ND 1.38E-03 ND ND <td>Benzene "</td> <td>71-43-2</td> <td>6.635-03</td> <td></td> <td>6.56E-04</td> <td>- 1</td> <td>_</td> <td>255-03</td> <td></td> <td>7.17E-04</td> <td></td> <td></td> <td>6.94E-CC</td> <td>6.86E-04</td>	Benzene "	71-43-2	6.635-03		6.56E-04	- 1	_	255-03		7.17E-04			6.94E-CC	6.86E-04
2765.04 ND ND 2765.04 ND ND 10005.400 2765.04 ND ND 2765.04 ND 0005.40 ND ND 2765.04 ND 0005.40 ND ND ND 2765.04 ND N	1,2-Dichloroethane H	107-06-2		2.45E-03			9		2.79E-03		2.76E-04	g	Q	9
278E-04 ND ND 100E-00 278E-04 ND ND 278E-04 ND ND ND 6.50E-01 2.78E-04 ND ND 6.50E-01 2.78E-04 ND ND 6.50E-01 2.78E-04 ND ND 0.00E+00 2.78E-04 ND ND 0.00E+00 2.78E-04 ND ND 0.00E+00 2.78E-04 ND ND 0.00E+00 2.78E-04 ND ND 1.38E-03 ND ND ND 2.78E-04 ND ND ND 1.38E-03 ND ND ND 1.38E-04 ND ND ND 1.38E-04 ND ND ND 1.38E-04	Trichloroethene H	79-01-6		2.45E-03			9		2.79E-03		2.76E-04	ş	g	£
0.00E+00 2.78E-04 ND ND 0.00E+00 2.78E-04 ND ND 2.78E-04 ND ND ND 5.278E-04 ND ND ND 5.278E-04 ND ND ND 6.524-03 2.78E-04 ND ND 6.524-04 2.78E-04 ND ND 0.00E+00 1.38E-03 ND ND 1.38E-03 ND ND <td< td=""><td>1 2-Dichloropropane "</td><td>79-67-5</td><td></td><td>2.45E-03</td><td></td><td>- 1</td><td>Ŷ</td><td>-</td><td>2.79E-03</td><td></td><td>2 76E 04</td><td>Ş</td><td>Ð</td><td>9</td></td<>	1 2-Dichloropropane "	79-67-5		2.45E-03		- 1	Ŷ	-	2.79E-03		2 76E 04	Ş	Ð	9
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1365-00 2765-01 ND ND 5.316-01 2.7165-01 ND ND 6.516-01 2.7165-01 ND ND 6.516-01 2.7165-01 ND ND 6.516-01 2.7165-01 ND ND 0.006-00 2.7165-01 ND ND 1.386-03 ND ND ND 1.386-03 ND ND ND 1.386-03 ND ND ND 1.386-04 ND ND ND 1.386-03 ND ND ND 1.386-04 ND ND ND 1.386-04 ND ND <td>I oluene "</td> <td>E-99-901</td> <td>0.005+00</td> <td></td> <td></td> <td>-</td> <td>+</td> <td></td> <td></td> <td>0.005+000</td> <td>101010</td> <td>1</td> <td>0.005+00</td> <td></td>	I oluene "	E-99-901	0.005+00			-	+			0.005+000	101010	1	0.005+00	
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6.34E-04 2.55E-04 NO NO 6.34E-04 2.55E-04 NO 0.56EE-03 0.00E-00 2.55E-04 NO 0.00E-00 0.00E-00 2.55E-04 NO NO 0.00E-00 2.57EE-04 NO NO 0.00E-00 2.57EE-04 NO NO 0.00E-00 1.38E-03 NO NO 0.00E-00 1.38E-03 NO NO 0.00E-00 1.38E-03 NO NO 1.38E-03 NO NO NO 1.38E-03 NO NO NO 1.38E-04 NO NO NO 1.38E-04 NO NO NO 1.38E-03 NO NO NO 1.38E-04 NO NO NO 1.38E-03 NO NO NO 1.38E-04 NO NO NO 1.41E-04 1.38E-04 NO NO 1.38E-04 NO NO	TH			2.455-00			2 9	-	2./95-03		2 765 04		2 2	2 9
6.34E-U 2.02-04 00 5.65E-0 0.00E-00 2.75E-01 0.00E-00 0.00E-00 0.00E-00 2.75E-01 N0 N0 1.38E-03 N0 N0 N0		101-121		2.100.00		1		1			705.01		2	2
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6.625-01 2.75E-04 Mon 4.95E-01 0.00E+00 2.75E-04 Mo Mon 1.38E-03 Mo Mon Mon 2.75E-04 Mo Mon Mon 1.38E-03 Mo Mon Mon 1.38E-04 Mon Mon Mon 1.38E-04 Mo Mon	City Delizere	4 14 10 1			0.000							1		L ME-W
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276E of 000E+00 276E of 000E+00 000 0 276E of 276E of 000E+00 0 000E+00 138E of 000E+00 0 0 0 138E of 000E+00 0 0 0 0 138E of 0 0 0 0 0 0 138E of 0 0 0 0 0 0 0 138E of 0 0	Civiane H	10.42.F	2	S AFE.TR			⊢	3	2 79E-03		2.76E-04	••••	g	9
0.00E+00 2.75E-04 J 0.00E+00 2.75E-04 NO NO NO 0.00E+00 2.75E-04 NO NO 0.00E+00 1.36E-03 NO NO 1.38E-03 NO NO NO 1.38E-03 NO NO NO 2.75E-04 NO NO NO 1.38E-03 NO NO NO 2.75E-04 NO NO NO 1.38E-03 NO NO NO 1.38E-04 NO NO NO 1.455 2.755 NO NO 1.455 2.755 NO NO 1.455 1.455 NO NO 1.455	1 1 2 2-Tetrachinmethane H	79.45		2 AFF-UP		1	S		2 79F-03		2,766-04	ŀ	2	2
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1.36:43 ND ND 0.00E-60 1.36:43 ND ND 2.76E-04 ND ND ND 1.38:63 ND ND ND 2.76E-04 ND ND ND 1.38:61 J 4.41E-04 J 2.76E-04 ND ND ND 1.38:61 J 4.41E-04 J 2.76E-04 ND ND ND 1.38:61 J 4.41E-04 J 2.36:62 J J 4.41E-04 J 1.38:61 J J 4.41E-04 J 1.38:61 J J J J 1.44:61 J J J J 1.44:61 J J J <td>trans-1, 2-Dichloroethene</td> <td>156-60-5</td> <td></td> <td>2.45E-03</td> <td></td> <td></td> <td>QN</td> <td></td> <td>2.79E-03</td> <td></td> <td>2.76E-04</td> <td></td> <td>Q</td> <td>2</td>	trans-1, 2-Dichloroethene	156-60-5		2.45E-03			QN		2.79E-03		2.76E-04		Q	2
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1.36E.01 ND ND 1.36E.03 ND ND 1.36E.03 ND ND 1.36E.04 ND ND 1.36E.04 ND ND 1.36E.04 ND ND 1.36E.04 ND ND 1.41E.04 2.76E.04 ND 2.36E.03 ND ND 1.41E.04 2.76E.04 ND 2.36E.03 1.42E.03 1.42E.03 2.36E.04 ND ND 1.41E.04 1.42E.03 1.42E.03 2.36E.03 1.41E.04 1.42E.03 2.36E.03 1.41E.04 1.42E.03 2.36E.04 1.41E.04 1.42E.03 2.36E.03 1.41E.04 1.42E.03 2.36E.04 1.41E.04 1.42E.03 2.36E.04 1.41E.04 1.42E.03 2.36E.04 1.41E.04 1.42E.04 1.41E.04 1.44E.04 1.44E.04 1.41E.04 1.44E.04 1.44E.04 1.41E.04<	2-Butanone (MEK) ^H	78-53-3	0.00E+00		0.00E+00			99 <u>4</u> 90		0.00E+00		-	0.00E+00	0.00E+00
Attecut 1 (38:00) ND ND 278:54 ND ND ND 278:54 ND ND ND 278:54 ND ND ND 278:54 ND ND ND 1 (38:00) 2 (38:00) ND ND 2 (38:150) 2 (35:160) 1 (35:00) ND 1 (38:00) 1 (38:00) ND ND 1 (38:00) 1 (38:00) 1 (38:00) 1 (38:00) 1 (38:00) 1 (38:00) 1 (38:00) 1 (38:00)	Bromodichloromethane	75-27-4		2.45E-03			£		2.79E-03		2.76E-04		Ð	2
1.16-00 NO NO 2.766-01 NO NO 2.766-01 NO NO 4.116-04 J 4.206-03 1.316-05 J 2.266-03 1.316-05 J J 2.266-03 1.316-05 J J 2.266-03 1.316-05 J J 2.266-03 1.316-05 J J J 1.316-05 J J J 1.316-05 J J J <td>4-Methyl-2-pentanone (MIBK) ^H</td> <td>108-10-1</td> <td></td> <td>1.236.02</td> <td></td> <td></td> <td>2</td> <td></td> <td>1.39E-02</td> <td></td> <td>1.365.63</td> <td></td> <td>29</td> <td>29</td>	4-Methyl-2-pentanone (MIBK) ^H	108-10-1		1.236.02			2		1.39E-02		1.365.63		29	29
236E-01 NO NO 1.1 200 2.06E-01 NO NO 2.06E-02 J 2.05E-03 2.36E-03 J 2.05E-03 2.36	Z-Mexanone	+		7,455,00			2 S	-	2.30E-UZ		7.5E-04		25	2 5
276E-04 ND ND 1.11E-04 J 122E-03 2.35E-03 J 232E-03 2.35E-04 J 232E-03 2.35E-04 J 232E-03 2.35E-04 J 232E-03 1.125E-04 J 232E-04 2.35E-04 J 232E-04 2.35E-04	Promoting and the Constraint House and the stream			2.45E.00			29		2.79E-03		2.76E-04	1	2	ŝ
4.416.04 J 4.266.00 2.816.00 2.566.00 1.2566.0000000000000000000000000000000000	cis-1 2-Dichloroethene	166-69-2		2.45E.03		· · · ·	N0		2.79E-03		2.76E-04		Ŷ	9
2.816.40 2.206.40	1 3-Butadiene H	106-99-0	4.17E-03		4.13E-04		4	466-03		4.41E-04		-	4.32E-03	4.27E-04
 Compound and feterate at this detaction lime. Compound may be present at a value teas than the detaction lime. Compound present in the laboratory bank greater than reporting and Restarts are stillmater, value reported is orded inter wording range. Exceeds organization and and another product range. The associated cumminated value is an estimated value if this is har State eccorregiver and was not met an equired direction limits or quality control criteria ware not met. The associated cumminated value is an estimated value in the reported concentration ware lass than the required direction limits or quality control criteria ware not met. The associated cumminated value is an estimated starting value that he sample to the analytical multipoint. The associated cumminate value is an estimated value of the sample concentration in the order of the starting value is a startification of the sample of the sample value is due to the quality control criteria ware not met. The associated cumminate value is a concretely and ware word meas the analyte in the associated cumminate and meas or measure and meas or concretely and ware word measure in the associated cumminate and meas or measure in a startification in the sample or to the quality criteria control or contained and or criteria ware word measure as the associated cumminate and meas or measure in the control or contained and or criteria ware with the measure that a sample value. The according to the sample word ware contained or upper due to the contained or upper due to the contained or upper due to the contained or contained or upper due to the contained or contained or the sample word or contained or the contained or contained or contained or the contained or upper due to the contained or the contained or the contained or the contained or upper due to the contai	HAP Total		2.00E-02		1.98E.03		~	IDE OZ		2.B1E.03			2.555.02	2.52E-03
- Reads are scimated, autor reported is outside innew working range. - Exceeds quality control lime, for example of this is the X, sylor recordy limit was not met. - The analysis was not directed above his restination with the analytical method. Dervers, the start and the required detection limit is approximate, and restored to a present - The analytic was not directed above his restored sample water starts the analytical method. Dervers, the start and the required detection limit is approximate, and restored control of the start and the required detection limit is a proximate, and may corring not - The analytic was not directed above his restored sample metauration into the sample. This is due to be guilty critical on understand the required detection limit is approximate, and may corring not - The analyte media blank andor sample field blank rates who times the sample neut should be considered suspect due to contamination. - The according blank andor sample field blank rates who times the sample neut should be considered suspect due to contamination.	 Compound not detected at this detection it Compound present in the laboratory blank gr. 	mit. Compound may eater than reporting liv	be present at a . ntt.	value lass than	the detection	iturit.								
The associated numerical value is an estimated quarity because the reported concentrations were all set that and direction limits or quality contral criteria were not met. U. The analytic was on disteriated above intro predictation in the sandylical method. However, the reported much criteria and may currary not represent U. The analytic was on disteriated above intro predictation in the sandylical method. However, the reported much criteria and may currary not represent D. The example media basic andor example field black value with two times the sample neutral shorted example report due to contramination. - This compound is listed as a herardous air policiant (Hu ²).	 Results are estimated, value reported is outs Exceeds quality control limits. (An example 	of this is the % spike	ge. recovery limit w	'as not met.)										
The actual line of quantitation necessary to accurately measure the earlyte in the sample. This is due to the quarky officient not being met. - The sample media blank and/or sample field blank value with two limes the sample value. Sample neuts shoud be considered augest due to contamination. - This compound is taked as a hazardous are pollutant (HAD).	 The associated numerical value is an estimat The analyte was not detected above the rep. 	ted quantity because 1 orted sample quantite	tion limit freport	ing limit for the	re less than the transferred met	e required dete hod). However	the reco	ted quantity	control criter	a ware not me approximate al	t nd may or ma	y not rep	oresent	
This compound is listed as a hazardous sir pollutant (MAP)	the actual limit of quantitation necessary to	accurately and precis	the measure the	e energie in the	e sample. This	is due to the q	puelity crit	aria nol beir	g met.					
	- This compound is listed as a hazardous air p	pollutant (HAP).												
	rijegijaji (jerriđanoskodo 40 rozo os skolu y staljego og skorat do istrikovstvo s	······												

TABLE 6-12. F119-PW-100 EMISSIONS FACTOR SUMMARY VOLATILE ORGANIC COMPOUNDS (VOCs) Military (Flow by Tracer)

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				-	ř	Kun Number		ſ			, , T	
Flow Rate, dscfm			-	623426		-		1823426			No.	Average
		<u>म</u>	thri.	leui adi 000 l/sdi	-		îb/hr		lbu/ sdi 000 hadi	is fuel		
Analyte	CAS Number	Detected	Defection	Detected Li	Detection	Detected	Detection	2	Letre	Detection		lbs/1,000 lbs
Chloromethane H	E-78-47	0 00E+00				Ē	-		0.005+000		0.00E+00	000+400
Vinyl Chloride "	75-01-4		3.23E-03	1.73			3.62E-03	ខ្ព		1.94E-04 ND		Ð
	74-839		1.61E-02	8.67E-04		QN	1.81E-02	ß		9.72E-04 ND		Ð
Freen 11 (Trichlorofluoromethane)	75.64.4	1945.00	3.23E-03	E7.1	1.73E-04		3.62E-03	_		1.94E-04 ND		Q
1,1-Dichloroethene H	75:35.4		3.23E-03		1.736-04	ND 2.24E-U	112 3 KDF-JTA	-	ZIER		2.09E-02	1.12E-03
Methylene Chloride H	75-09-2	0:00E+00		0.00E+00		00490010		0.00 +00	Ę		6	0.00F400
1,1-Dichlaraethane	E1/E-5/		3.23E-03	1.73		Ц	1.	H		1.94E-04 ND	-	QN
1 1.1.Tricklornethand H	F-99-14		3.235.03	£7		Ð	3.62E-03	8			Q	QN
Carbon Tetrachloride H	65.245	2 EDE-M	3.235-413	1.73	1.736-04		3.62E-03	+		1.94E-04 ND		9
Benzene H	71-43-2	1.13E-02		6.07E-04		6 RRF-TR	3 8	3 705 04	5	-	3.015-03	1.62E-04
1,2-Dichloroethane H	107-06-2		3.23E-03		1.736-04	DI DI	3.62E-03	╀	5	1.94E-04 NC		ND CIN
Trichloroethene "	79-01-6		3 Z3E-03	1.73	1.73E-04	QN	3.62E-03	8		1.94E-04 ND		2
1 -Z-Dicritoropropane	78-87-5		3.236-03	1.73	- 1	Q	3.62E-03	8				QN
Toluana H	970-1001	000	3.23E-03	0.73	1.73E-04	Q	3.62E-03	+		1.94E-04 ND		Q
cis-1.3-Dichloropropene H	10061-01-5		3 775.00		736.04		B	0.00E+00	ş		5	0.00E+00
1,1,2-Trichloroethane ^H	79-00-5		3 79F.M	1.735.04			3.62E-U3	3 8	t		2	2
Tetrachloroethene H	127-18-4		3 23E-03	1 73F.04	1	2 12	3.625-03	3 8	-			2
Chlorobenzene H	108-90-7		3.Z3E-03	1.73E-04		2 2	3 675-03		+	1		
Ethyl Benzene ^H	100-41-4	3.16E-03		1.70E-04		-	3.62E-03			- n	Ξ	1.82E-04
m.p-Xylene "	108-38-3	7.75E-03		4.15E-04			3.62E-03	8		t		3.05E-04
o-Xylene "	95-47-6	2.65E-03		1.42E-04	1		3.62E-03	8				1.685-04
Siyrene	100-42-5		3.23E-03	1.73E-04		Q	3.62E-03	8		e	g	Q
1,1,2,2,16trachioroethane	79:345		3.23E-03	1.73E-04		QN	3.62E-03	-+		1.94E-04 ND	4	9
Carbon Disulfide H	75,15.0	1 745-00		D.UUE+UU			8 8		Ę	•	0:00E+00	0.00E+00
trans-1, 2-Dichloroethene	156-60-5		3.23E-03	1 735-0	-	UN 1.305-UN	1675.00	1.36-10 1	9			6.99E-US
Vinyi Acetate H	108-05-4		1.61E-02	8.67E-04	1.1	Q	1.816-02	28				2 G
2-Butanone (MEK) ⁴	78-93-3	D:00E+00		0.00E+00		R 0.00E+00		D.00E+00		11	8	0.00E+00
Bromodichloromethane	75-27-4		3.23E-03	1.73E-04	1	QN	3.62E-03	Ц	ļ	1.94E-04 ND	⊢	QN
4-Meinyr-Z-pentanone (MiBK)	108-10-1 col 70.c		1.616.00	8.67E-04		Q	1.81E-02	8		-+	QN	Q
Dibromochloromethane (Chlorodibromomethane)	124-48-1		3 235-03	1 73F-04	-+-		1.815-1	36		9.72E-04 ND		22
Bromoform #	75-25-2		3.23E-03	1.736-04	t	2	3.62E-(· · · · ·		2 2
cis-1,2-Dichloroethene	156-59-2		3.23E-03	1.73E-04	ŀ···†	Q	3.62E-03	2			Ц	QN
1,3-Bufadiene	106-99-0	2 2 2 2 2	1.61E-02	8.67E-04		м	1.B1E-02			9.72E-04 W	1.71E-02	9.20E-04
ND - Compound not detected at this detection limit.	Compound may be present at a value less than the detection limit.	e present at a v	alue fass than	1.34E-U3 the detection limit.		1.17E-02	8	6.26E-04	3		4276-02	2.30E.03
B - Compound present in the laboratory blank greater than reporting limit. E - Results are estimated value reported is outside linear working range.	er than reporting lim linear working rand	<i></i>							T.			
0 - Exceeds quality control limits. (An example of this is the % spike recovery limit was not met.)	is is the % spike r	scovery limit wa	is not met.)	and the second sec	1							
- In a second on manual where is a maintair duration is needed constrations were less than the neginide constrations were and a decision france or quarky constrations and mark in a marking in the constration of the product data and the mark in a mark in	d sample quantitat	e reported conc on limit (reporti	entrations were	e less than the require analytical method). H	d detect	on limits or g he reported o	uality control cr santitation limit	iteria were no is approxima	it met	av or may not n	orecont	
the actual limit of quantitation necessary to accurately and pracisely measure the analyte in the sample. This is due to the quality criteria not being met.	urately and precise	ly measure the	analyta in the	sample. This is due t	o the qui	lity criteria no	il being met.		•••••			
H - This compound is listed as a hazardous air pollutant (HAP).	tant (HAP).					and Loadsos		é é				
Besitis inorted as 0.00 intrains Administration of the statement of	and a second						·					
Note: Compounds analyzed in this neilitant mouse an a standard screen list for incomparisation of the schedust stream.	a posiciani concent are a standard rom	ation greater in	an the detected	d politicali concentrati	on in the	exhaust stre	Ē					
		מחתוה ובולפי ווס	I TUT THE BURNIN	Cal meinog and are nu	I heces	santy combusi	ton oy-product	s from this en	i .euibe			

Test Report Section 6 Revision 2 June 2002 Page 25 of 36 TABLE 6-13. F119-PW-100 EMISSIONS FACTOR SUMMARY SLIPSTREAM DUCT ALDEHYDE/KETONES (Flow bv Tracer)

······································							TOW DY HAUGH	y 11a	רפו /		•										-	-
				Idle		$\left \right $		Aner	oach	ŭ	cagine mode	886	Inter	Intermediate					Miltarv			- 1
Flow Rate, dscfm				269029				138	663682				1	1458213		ſ			1823426			1
		Ib/hr	ľ	lbs/1,000	lbs fuel		lb/hr		lbs/1,000, lbs fuel	bs fuel		IbAr		lbs/1 000 lbs fuel	lbs fuel		4		Ibs/1,000 lbs fuel	O Ibs fuel		1
			Detection		Detection		á	Detection		Detection			Detection		Detection	-		Detection		Detection	Ę	
Analyte	CAS Number	Detected	Limit	Detected	Cimit	å	Detected	Limit	Detected	Ĩ		Detected	Limit	Detected	Ľ		Detected	Ľ	Detected	Limit		-
Formaldehyde ^H	50000	1.37E+00		9.98E-01		J 9.7	9.75E-02		3.56E-02		-	2.47E-01		2.45E-02		-	1.41E-01		7.59E-03		5	
Acetaldehyde ^H	0-20-52	1.53E-01		1.11E-01		J. 1.B	1.05E-02		6.76E-03		-	2.64E-02		2.61E-03		-	1.56E-02		B.31E-04		L	
Acrolein H	107-02-8	4.96E-02		3.60E-02		 -		3.666-02		1.33E-02	з		1.65E-02		1.635-03	З		3.44E-02		1.05E-03	3 W	
Acetone	67-64-1	3.21E-01		2.33E-01		J 1.1.	1.17E+00		4.27E-01		ſ	6.26E-01		6.20E-02		ſ	9.93E-01		5.33E-02		-	
Propenal	123-38-6	2.21E-02		1.61E-02				3.66E-02		1.33E-02	З	9.895-03		9.78E-04		-	7.64E-03		4.10E-04		. ا	
Crotonaldehyde	4170-30-3	3.66E-02		2.666-02		<u> </u>	Ē	3.66E-02		1.33E-02	3		1.66E-02		1.695-03	3		3.44E-02		1.85E-03	ш Ш	_
Isobutyraidehyde / Methyl Ethyl Ketone H	78-93-3	9.16E-02		6.65E-02		-	m	3.66E-02		1.30E-02 W	з		1.665-02		1.E3E-03	З		3.44E-02		1 85E-03	Ш Ш	
Benzaldehyde	100-52-7	5.72E-02		4.16E-02		-		3.66E-02		1.336-02	з		1.666-02		1.63E-03	З		3.44E-02		1.85E-03	ш. Б	
Isopentanai (Isovaleraidehyde)	690-96-3		6.49E-02		4.71E-02 W	3	e,	3.66E-02		1.33E-02	3		1.65E-02		1.63E-03	3		3.44E-02		1.86E-03	a w	
Pentanal (Valeraldehyde)	110-62-3		6.49E-02		4.71E-02 W	3	<u> </u>	3.66E-02		1.33E-02	з		1.66E-02		1.63E-03	3		3.44E-02		1.86E-03	а В	
o-Tolualdehyde	529-20-4	3.82E-02		2.77E-02			£	166E-02		1.33E-02	З		1.65E-02		1.63E-03	m e	8.02E-03		4.31E-04			-
m,p-Tolualdehyde	620-23-5	2.63E-02		1.91E-02		-	e.	3.66E-02		1.33E-02	З	1.19E-02		1.17E-03		.	3.06E-03		1.54E-04		-	-
Hexanal (Hexaldehyde)	104-87-0		6.49E-02		4.71E-02 (m		3.66E-02		1.33E-02	m		1.66E-02		1.63E-03	3		3.44E-02		1.86E-03	З	-
HAP Total		1.67E+00		1.21E+00		-	1.16E-01		4.24E-02			2.74E.01		2.71E-02			1.576.01		8.42E.03			
											•									:	-	
ND - Compound not detected at this detection fimit. Compound may be present at a value less than the detection limit	ion timit. Compoun	id may be prese	ent at a value le:		Action limit.			,					.,									
A - The associated numerical value is accepted. Procedures from which value was obtained meets the qua	pted. Procedures t	from which value	e was obtained		ity control criteria as defined by the DQAP.	a as define	ed by the DQ	¢.		And the second second					•	1					-	• 77
B - Compound present in the laboratory blan	nk greater than repu	oding limit.																÷				
E - Results are estimated, value reported is outside linear working range.	outside linear work	cing range.						· · · · · · · · · · · · · · · · · · ·													ł	
Q - Exceeds quality control limits. (An example of this is the % spike recovery limit was not met.)	mple of this is the 9	6 spike recovery	Y limit was not i											÷ · · · · · · · · · · · · · · · · · · ·								
3 - The associated numerical value is an estimated quantity because the reported concentrations were less	timated quantity be	icause the repor	tted concentrati	ons were less to	than the required detection limits or quality control criteria were not met.	detection	limits or qual	lity control cn	iteria were not	met.				•	:	; ;	;					
W - The analyte was not detected above the reported sample quantitation limit (reporting limit for the analyt	e reported sample .	quantitation limi	t (reporting limi	for the analytic	ical method). However, the reported quantitation limit is approximate and may or may not represent	vever, the	reported qua.	ntitation limit	is approximat	e and may o	r may no	t represent										
the actual limit of guantitation necessary to accurately and precisely measure the analyte in the sample	hy to accurately an	id precisely mea	sure the analy	e in the sample	 This is due to the quality criteria not being met. 	the quality	Y criteria not	being met					•									
bb - The sample media blank and/or sample field blank value with two times the sample value. Sample result	s field blank value w	with two times th	le sample value	Sample result		idered su:	spect due to r	contamination	Ē												-	1
H - This compound is listed as a hazardous air pollutant (HAP).	: air pollutant (HAP					:																

Results, reported as 0.00 indicate a detected ambient poliudant concentration greater than the detected poliulant concentration in the exhaust stream. Note: Compounds analyzed in this pollutant group are a standard compound target list for the analytical method and are not necessarily combustion by products from this engine. Test Report Section 6 Revision 2 June 2002 Page 26 of 36

TABLE 6-14. F119-PW-100 EMISSIONS FACTOR SUMMARY ENGINE RAKE BENZENE (Flow by Carbon Balance)

	· · · · · · · · · · · · · · · · · · ·		The second se			den eksender i fridde sons in en denddender in in in en e
			Engin	Engine Mode		
		ldle			Approach	-
Flow Rate, dscfm		39646	46		71633	
			lbs/1,000		lbs	lbs/1,000
Analyte	lb/hr		lbs fuel	lb/hr	â	lbs fuel
Benzene	1.66E-01		1.21E-01	8.31E-03	3.0	3.03E-03
ND - Compound not detected. Value is the method detection limit.	method detect	ion limit				
A - The associated numerical value is accepted. Procedures from which	ted. Procedur	'es from	which			
value was obtained meets the quality control criteria as defined by the DQAP.	ntrol criteria as	s define	d by the DQAP.	A THE REAL AND A		a da faren aran da menda a la rena da menereza da mantena da menereza da mantena da menereza da mantena da mene
B - Compound present in the laboratory blank greater than reporting limit.	k greater than	reportir	ig limit.			
E - Results are estimated, value reported is outside linear working range.	outside linear v	working	range.			
Q - Exceeds quality control limits.						
J - The associated numerical value is an estimated quantity because the reported	imated quantity	y becau	ise the reported			
concentrations were less than the required, detection limits or quality control criteria were not met.	ed, detection li	mits or	quality control cri	teria were not m	et.	
UJ - The analyte was not detected above the reported sample quantitation limit. However,	reported sam	ple qua	ntitation limit. Ho	wever,		
the reported quantitation limit is approximate and may or may not represent the actual limit	imate and may	r or may	r not represent th	e actual limit		
of quantitation necessary to accurately and precisely measure the analyte in the sample.	and precisely r	neasure	e the analyte in th	e sample.		
This is due to the quality criteria not being meet.	ng meet.				•	
bb - The sample media blank and/or sample field blank value with two times the sample value.	field blank valu	Je with	two times the sar	nple value.		
Sample result should be considered suspect due to contamination.	spect due to ci	ontamir	lation.			

Test Report Section 6 Revision 2 June 2002 Page 27 of 36

(Flow by Carbon Balance Film Rate, dsc/m Engine Mode Flow by Carbon Balance Film Rate, dsc/m Internet Engine Mode Plont Film Rate, dsc/m Internet Internet Plont Formalderyde Internet Internet Plont Formalderyde Internet Internet Plont Formalderyde Internet Internet Plont Contonalderyde Internet Internet Plont Contonalderyde Internet Internet Internet Contonalderyde Intere </th <th></th> <th></th> <th>ALDEHYDE</th> <th>ALDEHYDE/KETONES</th> <th></th> <th></th>			ALDEHYDE	ALDEHYDE/KETONES		
Engline Mode Engline Mode Fundation Approach Approach Flw Rate, Gsc(m ibm ibm </th <th></th> <th>999 - 9 19 191 191 191 191 191 191 191 1</th> <th>(Flow by Car</th> <th>rbon Balanc</th> <th>ð</th> <th></th>		999 - 9 19 191 191 191 191 191 191 191 1	(Flow by Car	rbon Balanc	ð	
File Rate, discrim Jale Appresent Appresent File Rate, discrim 1416 Appresent 1633 Arrafyte b/n b/n b/n b/n b/n Frematerva b/n b/n b/n b/n b/n b/n Frematerva b/n b/n b/n b/n b/n b/n b/n Accordin b/n 006E-00 b 1.48E-01 1.48E-01 2.25E-02 b b/n b/n Accordin b/n 156E-01 1.19E-01 1.26E-01 1.26E-01 1.26E-01 b 2.76E-03 b 2.76E-	18 TO PARTYON PARAMA SUCCESSION AND AND AND AND AND AND AND AND AND AN		Engine	e Mode	AND ADDRESS OF THE OWNER ADDRESS OF	
Flow Rate, discrim Tiges/100 Triangle Tiges/100 Tiges/100 Arrabyte bohr be full be full be full be full bes full Arrabyte be full be full be full be full be full bes full Arrabyte be full be full be full be full be full be full Arrabyte be full be full be full be full be full be full Acrement be full be fulle be full be full be full be full Acrement be fulle be fulle be fulle be fulle be fulle be fulle Acrement be fulle be fulle be fulle be fulle be fulle be fulle Acrement be fulle Acrement be fulle <			Idle	Ap	proach	
Analyte behr behr <thbohr< thr=""> behr behr</thbohr<>	Flow Rate, dscfm		39646		71633	
Analytic Induction Ibin Ibs fael Ibin Ibs fael Ibin Ibs fael Ibin Ibs fael Ibin Ibin <thibin< th=""> Ibin Ibin <</thibin<>			lbs/1,000		lbs/1,000	
Considering 1.78E-400 1.29E-400 1.40E-01 6.46E-01 B 6.46E-01 B 6.46E-01 B 6.46E-01 B 2.36E-02 B 2.36E-03 J 3.76E-03 <	Analyte	lb/hr	lbs fuel	lb/hr	lbs fuel	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Formaldehyde	1.78E+00	1.29E+00	1.40E-01	5.09E-02	
Acrolein Corole-on 0.00E-00	Acetaldehyde				-	
$\label{eq:constraints} \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Acrolein	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1913 A. 1917
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Acetone	1.63E-01	1.19E-01	1.40E-02	5.09E-03	
Contonellerivel 1.635-00 1.195-00 1.195-00 1.195-00 2.705-03 2.705-03 1 Isoburtralderivels 1.355-01 916-00 1.165-03 1.315-03 1 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03 3 3.315-03	Propanal			2.25E-02 J	8.23E-03 J	a real name of a first state and a maximum construction on a second
Isoburtralder/yde/ Benzalder/yde/ (appentanal (georaleratider/yde) I 13E-01 B 63E-02 1 13E-03 J 705E-03 J 371E-02 U 371E-02 U 276E-02 J 13E-03 J 371E-03 J 371E-03 <th< td=""><td>Crotonaldehyde</td><td>1.63E-02 J</td><td>1.19E-02 J</td><td>7.41E-03</td><td>2.70E-03</td><td></td></th<>	Crotonaldehyde	1.63E-02 J	1.19E-02 J	7.41E-03	2.70E-03	
Benzaldehyde 1.35E-01 981E-02 1.18E-02 4.31E-03 4.31E-03 4.31E-03 4.31E-03 4.31E-03 1.35E-04 0 Pentanal (Yalesvaleradehyde) 3.71E-02 U 2.70E-02 U 2.56E-03 U 9.78E-04 U 9.78E-04 U Pentanal (Yalesvaleradehyde) 1.05E-01 U 2.70E-02 U 2.15E-03 U 9.34E-03 J Hexad U HExad U 1.48E-03 J J Hexad J Hexad J <td><u> </u></td> <td>-</td> <td>8.63E-02</td> <td>1.93E-02 J</td> <td>7.05E-03 J</td> <td></td>	<u> </u>	-	8.63E-02	1.93E-02 J	7.05E-03 J	
Isopentanal (Sevaleratedehyde) 371E.02 U 270E.02 U 270E.03 J 750E.04 J Pentanal (Valeratedehyde) 371E.02 U 270E.03 J 750E.03 J J 750E.03 J 750E.03 J J J J 750E.03 J	Benzaldehyde	1.35E-01	9.81E-02	1.18E-02	4.31E-03	
Pentanal (Valeraldehyde) 371E-02 U 276E-02 311E-03 1783E-04 J or Toluladehyde 6.04E-07 7.66E-02 311E-03 1.14E-03 1 m.p. Toluladehyde 6.02E-02 4.53E-02 3.37E-03 3.11E-03 1.14E-03 M.D. Compound motected: Value is the method detection limit. 6.03E-02 4.42E-02 3.97E-03 1.44E-03 N.D. Compound motected: Value is the method detection limit. 1.44E-02 3.97E-03 1.44E-03 1.44E-03 N.D. Compound motected: Value is the method detection limit. A. 47E-02 3.97E-03 1.44E-03 1.44E-03 N.D. Compound present in the laboratory blank greater than reporting limit. A. 47E-02 3.97E-03 1.44E-03 1.44E-03 R. Compound present in the laboratory blank greater than reporting limit. A. 47E-02 3.97E-03 1.44E-03 1.44E-03 D. Compound present in the laboratory blank greater than reporting limit. A. 47E-02 3.97E-03 1.44E-03 1.44E-03 D. Exceeds durit were less than the reported Compound present in the laboratory blank greater than reported A. 44E-04 A. 44E-03 A. 44E-03	Isopentanal (Isovaleraldehyde)	3.71E-02 U		2.68E-03 U	9.79E-04 U	
o-Tolualdehyde 1.05E-01 7.66E-02 3.11E-03 1.14E-03 m.p-Tolualdehyde) 6.24E-02 9.34E-03 3.41E-03 3.41E-03 M.D Compound not detected. 8.09E-02 4.45E-02 3.97E-03 3.41E-03 M.D Compound not detected. Note-02 4.45E-02 3.97E-03 3.41E-03 M.D Compound not detected. Yalue is the method detection limit. 4.42E-02 3.97E-03 3.41E-03 M.D Compound not detected. Yalue is accepted. Procedures from which 3.41E-03 1.45E-03 Note was obtained meets the quality control criteria as defined by the DOAP. 1.45E-03 3.41E-03 1.45E-03 Note was obtained meets the quality control criteria as defined by the DOAP. 1.45E-03 1.45E-03 1.45E-03 O = Exceeds quality control criteria as defined by the DOAP. 1.45E-03 1.45E-03 1.45E-03 O = Exceeds quality control criteria as defined by the DOAP. 1.45E-03 1.45E-03 1.45E-03 O = Exceeds quality control criteria as defined by the DOAP. 1.45E-03 1.45E-03 1.45E-03 O = Exceeds quality control criteria as defined antint.	Pentanal (Valeraldehyde)			2.15E-03 J	7.83E-04 J	and have a manufacture of the second description of the second descrip
m.p. Tolualdehyde 6.24E-02 4.55E-02 9.34E-03 3.41E-03 3.41E-03 Hexanal (Hexaldehyde) 6.09E-02 4.42E-02 3.97E-03 1.45E-03 9 ND - Compound not detected. Value is the method detection limit. - The associated numerical value is accepted. Procedures from which value was obtained meets the quality control criteria as defined by the DOAP. 3.97E-03 1.45E-03 9 ND - Compound not detected. Value is the method detection limit. - The associated numerical value is accepted. Procedures from which value was obtained meets the quality control criteria as defined by the DOAP. - <td< td=""><td>o-Tolualdehyde</td><td>1.05E-01</td><td>7.66E-02</td><td>3.11E-03</td><td>1.14E-03</td><td></td></td<>	o-Tolualdehyde	1.05E-01	7.66E-02	3.11E-03	1.14E-03	
Hexanal (Hexaldehyde) 6.09E-02 4.42E-02 3.97E-03 1.45E-03 ND - Compound not detected. Value is the method detection limit. A The associated numerical yeal exercises from which value was obtained meets the quality control criteria as defined by the DOAP. A The associated numerical yeal exercises from which value was obtained meets the quality control criteria as defined by the DOAP. A The associated numerical yeal exercises from which value was obtained meets the quality control criteria as defined by the DOAP. A A The associated numerical yeal exercises from which value was obtained meets the quality control criteria as defined by the DOAP. A <t< td=""><td>m.p-Tolualdehyde</td><td>6.24E-02</td><td>4.53E-02</td><td>9.34E-03</td><td>3.41E-03</td><td></td></t<>	m.p-Tolualdehyde	6.24E-02	4.53E-02	9.34E-03	3.41E-03	
ND - Compound not detected. Value is the method detection limit. A - The associated numerical value is accepted. Procedures from which value was obtained meets are quality control criteria as defined by the DQAP. B - Compound present in the laboratory blank greater than reporting limit. E - Results are estimated, value is an estimated quantity because the reported O - Exceeds quality control limits. D - The associated numerical value is an estimated quantity because the reported D - The associated numerical value is an estimated quantity because the reported D - The associated numerical value is an estimated quantitation limit. However, the reported quantitation limit is approximate and may or may or may on the resent the actual limit. However, the reported quantitation limit is approximate and may or may or may or may or the sample. D - The sample media blank and/or sample field blank value with two times the sample. This is due to the quality criteria not being meet. D - The sample media blank and/or sample field blank value with two times the sample. D - The sample media blank and/or sample field blank value with two times the sample. Results are result in overlapping peaker during content curve limit. Results and isobury value a detected ambient pollutant concentration grader than the detected pollutant in the exhauts stream. D - The sample result is overlapping peaker during range. D - The sample media blank vand/or sample quantitation meet.	Hexanal (Hexaldehyde)	6.09E-02	4.42E-02	3.97E-03	1.45E-03	
ND - Compound not detected. Value is the method detection limit. ND - Compound not detected. Value is the method detection limit. A - The associated numerical value is accepted. Procedures from which Procedures from which B - Compound not detected. Value is accepted. Procedures from which Procedures from which B - Compound present in the laboratory blank greater than reporting limit. Procedures from which B - Compound present in the laboratory blank greater than reporting limit. Procedures from the laboratory blank greater than reporting limit. D - The associated numerical value is an estimated quantity because the reported concentrations were less than the required, detection limits or quality control criteria were not met. Procedures from the required, detection limits or quality control criteria were not met. U - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit. Procedures from the reported sample quantitation limit. However, the sample. U - The sample media blank and/or sample field blank value with two times the sample. Defendend blank value with wor times the sample. D - The sample media blank and/or sample field blank value with two times the sample. Defendend blank value with wor times the sample. D - The sample media blank and/or sample field blank value with two times the sample value. Defendend blank value with wor times the sample value. D - The sample realt shou						
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value was obtained meets the quality control criteria as defined by the DQAP. Nalue was obtained meets the quality control limit. B - Compound present in the laboratory blank greater than reporting limit. E - Results are estimated, value reported is outside linear working range. D - Exceeds quality control limits. D - Exceeds quality control limits. D - Exceeds quality control limits. D - Exceeds quality control limits. D - The associated numerical value is an estimated quantity because the reported P - Concentration were less than the required, detection limits to roution criteria were not met. U - The analyte was not detected above the reported sample quantitation limit. However, P - Exceeds quality criteria not behowe the reported sample quantitation limit. However, UL - The sample media blank and/or sample field blank value with two times the sample. P - The sample media blank and/or sample field blank value with two times the sample. Dr - This is due to the quality criteria not being meet. D - The sample media blank and/or sample field blank value with two times the sample. Dr - This is due to the quality criteria and being meet. D - The sample media blank and/or sample field blank value with two times the sample. Dr - This is due to the quality criteria not being meet. D - The sample media blank and/or sample field blank value with two times the sample. Dr - This is due to the quality criteria not being meet. D - The sample media blank and/or sam	A - The associated numerical value is accel	oted. Procedures fror	n which		**************************************	
B - Compound present in the laboratory blank greater than reporting limit. E - Results are estimated, value reported is outside linear working range. C - Exceeds quality control limits. J - The associated numerical value is an estimated quantity because the reported J - The associated numerical value is an estimated quantity because the reported Uu - The analyte was not detected above the reported concentrations were less than the required, detection limits or quality control criteria were not met. Uu - The analyte was not detected above the reported sample quantitation limit. However, the actual limit the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. This is due to the quality criteria not being meet. E manalyte in the sample. Sample result should be considered supper due to contamination. E secults and/or sample field blank value with two times the sample. Results reported as 0.00 indicate a detected ambient pollutant concentration greater than the detected pollutant in the exhaust stream. MEK and isobutyraldehyde result in overlapping peaks during analysis. Result could be either compound or combination of both.	value was obtained meets the quality co	ontrol criteria as defin	ed by the DQAP.			•
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UU - The analyte was not detected above the reported sample quantitation limit. However, Uuthe reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample. Image: Construct the quality criteria not being meet. Db - The sample media blank and/or sample field blank value with two times the sample. Image: Construct the quality criteria not being meet. Bb - The sample media blank and/or sample field blank value with two times the sample. Image: Construct the quality criteria not being meet. Bb - The sample result should be considered suspect due to contamination. Image: Construct the detected pollutant in the exhaust stream. MEX and isobutyraldehyde result in overlapping peaks during analysis. Result could be either compound or combination of both. Image: Construct the compound or combination of both.	concentrations were less than the requir	ed, detection limits o	r quality control criteri	a were not met.		
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This is due to the quality criteria not being meet. bb - The sample media blank and/or sample field blank value with two times the sample value. Sample result should be considered suspect due to contamination. Results reported as 0.00 indicate a detected ambient pollutant concentration greater than the detected pollutant in the exhaust stream. MEK and isobutyraldehyde result in overlapping peaks during analysis. Result could be either compound or combination of both. c- Analytical "peaks" overlap preventing determination of a single compound. Result could be either compound or combination of both.	of quantitation necessary to accurately	and precisely measu	re the analyte in the s	ample.		
bb - The sample media blank and/or sample field blank value with two times the sample value. Sample result should be considered suspect due to contamination. Sample results reported as 0.00 indicate a detected ambient pollutant concentration greater than the detected pollutant in the exhaust stream. MEK and isobutyraldehyde result in overlapping peaks during analysis. Result could be either compound or combination of both. C- Analytical "peaks" overlap preventing determination of a single compound. Result could be either compound or combination of both. 	This is due to the quality criteria not bei	ing meet.				
Sample result should be considered suspect due to contamination. Results reported as 0.00 indicate a detected ambient pollutant concentration greater than the detected pollutant in the exhaust stream. MEK and isobutyraldehyde result in overlapping peaks during analysis. Result could be either compound or combination of both. c- Analytical "peaks" overlap preventing determination of a single compound. Result could be either compound or combination of both.	bb - The sample media blank and/or sample	field blank value with	two times the sample	e value.		
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MEK and isobutyraldehyde result in overlapping peaks during analysis. Result could be either compound or combination of both. c- Analytical "peaks" overlap preventing determination of a single compound. Result could be either compound or combination of both.	Results reported as 0.00 indicate a detected	d ambient pollutant co	oncentration greater th	an the detected po	ollutant in the exhaus	st stream.
c- Analytical "peaks" overlap preventing determination of a single compound. Result could be either compound or combination of both.	MEK and isobutyraldehyde result in overlap	ping peaks during an:	alysis. Result could b	e either compound	or combination of b	oth.
	c- Analytical "peaks" overlap preventing detu	ermination of a single	compound. Result co	uld be either comp	ound or combination	of both.

TABLE 6-15. F119-PW-100 EMISSIONS FACTOR SUMMARY ENGINE RAKE ALDEHYDE/KETONES Test Report Section 6 Revision 2 June 2002 Page 28 of 36

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TABLE 6-16. F119-PW-100 SLIPSTREAM RAKE INTAKE SAMPLE POINT DATA COMPARISON

	Id	ldle	Approach	oach	Intermediate	ediate	MIN	Military
Sample Doint	(mmn) 00	сг, / то		ν, 1 .		1		
	co (pprri)	SF6 (ppm)	co (ppm)	SF6 (ppm)	co (ppm) SF6 (ppm) حد (ppm) SF6 (ppm) من المناعد (ppm) من المناعد (ppm) من المناعد (ppm) من المناعد (ppm) من ا	SF6 (ppm)	(mux (ppm)	SF6 (ppm)
1	53.0	0.265	8.5	0.104	11.0	0.102	29.5	0.097
2	53.5	0.259	8.5	0.107	10.0	0.104	30.0	0.086
3	55.5	0.260	6	0.111	11.0	0.104	32.0	0.084
4	58.0	0.249	6	0.109	12.0	0.103	36.5	0.083
5	60.0	0.247	6	0.108	12.0	0.103	37.5	0.084
9	62.0	0.249	6	0.109	12.0	0.103	37.0	0.083
7	54.0	0.250	8	0.109	10.0	0.107	30.0	0.085
8	53.0	0.255	8.5	0.112	10.0	0.105	30.0	0.086
6	54.5	0.248	8.5	0.112	10.0	0.106	32.0	0.083
10	54.0	0.245	8.5	0.109	10.0	0.105	34.0	0.079
11	49.5	0.234	8	0.107	10.0	0.103	32.0	0.080
12	47.5	0.239	8.5	0.107	10.0	0.103	31.5	0.077
Maximum	62.0	0.265	9.0	0.112	12.0	0.107	37.5	0.097
Minimum	47.5	0.234	8.0	0.104	10.0	<u>0.102</u>	29.5	0.077

Test Report Section 6 Revision 2 June 2002 Page 29 of 36 TABLE 6-17. F119-PW-100 EMISSIONS FACTOR SUMMARY PARTICULATES

Idle (Flow by Tracer)

Run Number			Run Number	ımber	K TI TE KANANGAN JA KANANGAN K			
		1		~	m		Ave	Average
Flow Rate, dscfm	289	289029	289	289029	289029	29		
		1bs/1,000		lbs/1,000		lbs/1,000		lbs/1,000
Analyte	lb/hr	lbs fuel	lb/hr	lbs fuel	lb/hr	lbs fuel	lb/hr	lbs fuel
Particulate (total)	3.999	2.904	3.216	2.336	3.082	2.238	3.433	2.493

Test Report Section 6 Revision 2 June 2002 Page 30 of 36

TABLE 6-18. F119-PW-100 EMISSIONS FACTOR SUMMARY PARTICLES Approach (Flow by Tracer)

		Ru	Run Number					
	1		• •	2	£		Ave	Average
Flow Rate, dscfm	283283		:99 98:	663582	663582	82		
		lbs/1,000		lbs/1,000		lbs/1,000		lbs/1,000
Analyte	lb/hr	lbs fuel	lb/hr	lbs fuel	lb/hr	lbs fuel	lb/hr	lbs fuel
Total Particulate	4.339	1.580	8.242	3.001	3.894	1.418	5.492	2.000

Test Report Section 6 Revision 2 June 2002 Page 31 of 36

EMISSIONS FACTOR SUMMARY PARTICULATES TABLE 6-19. F119-PW-100 Intermediate

	(Flow by Tracer)	racer)				
Run Number		Run N	Run Number			
			~		Ave	Average
Flow Rate, dscfm	1456	458213	1456	458213		
		lbs/1,000		lbs/1,000		lbs/1,000
Analyte	lb/hr	lbs fuel	lb/hr	lbs fuel	lb/hr	lbs fuel

1.408

14.239 lb/hr

1.324

13.387 lb/hr

15.091 lb/hr

Particulate (total) Analyte

lbs fuel 1.493 Test Report Section 6 Revision 2 June 2002 Page 32 of 36

TABLE 6-20. F119-PW-100 EMISSIONS FACTOR SUMMARY PARTICULATES MILITADY

PARTICULATES	MILITARY	(Flow by Tracer)	Run Number	

Run Number		Run Ni	Run Number			
		1		C '	Ave	Average
Flow Rate, dscfm	182	1823426	182	823426		
		1/sql		lbs/1,000		lbs/1,000
Analyte	lb/hr	lbs fuel	lb/hr	lbs fuel	lb/hr	lbs fuel
Particulate (total)	15.686	0.843	26.157	1.405	20.921	1.124

Test Report Section 6 Revision 2 June 2002 Page 33 of 36

TABLE 6-21 F119-PW-100 PARTICLE SIZE DISTRIBUTION

Particle Size		Eng	Engine Setting	Angele agente de l'angele page en une de las angeles de las accessos	ran meren an
Range (um) ^a	ldle (%)	Approach (%)	te (%)	Military (%)	
0.5 - < 2.5	70.5	86.3	8.77	86.6	
2.5 - < 5	15.8	5.8	14.7	8.6	ar men a su a s
5 - < 7.5	6.5	2.9	4.3	2.4	
7.5 - <= 10	4.3	2.7	e	1.7	
> 10	2.9	2.4	0.7	0.7	
	•••				
ο στο το τ	, , , , , , , , , , , , , , , , , , ,				
a - Based on aerodynamic particle diameter.	namic particl	le diameter.			
NOTES:					
Percentages shown based on particle count in each size range.	i based on ps	article count in eac	h size range.		
Blank analysis showed no filter contamination.	ved no filter c	contamination.			
The majority of the p	articles > 2.5	i um appear to be <u>c</u>	The majority of the particles > 2.5 um appear to be groups of smaller particles in the 0.03 - 0.05 um range.	cles in the 0.03 -	0.05 um range.

Test Report Section 6 Revision 2 June 2002 Page 34 of 36 TABLE 6-22 F119-PW-100 JP-8 FUEL METALS ANALYSIS

	Sample	Sample Number
Compound -		JP8-2
	(PPM)	(PPM)
Antimony	QN	Q
Arsenic	۵	QN
Barium	QN	QN
Beryllium	QN	QN
Cadmium	QN	QN
Chromium	QN	QN
Cobalt	ND	QN
Copper	0.054	0.03
Lead	DN	QN
Manganese	DN	QN
Mercury	ND	DN
Nickel	0.038	QN
Selenium	QN	QN
Silver	DN	QN
Thallium	QN	0.0075
Zinc	0.058	0.029
Phosphorus	0.35	0.17

Test Report Section 6 Revision 2 June 2002 Page 35 of 36 TABLE 6-23. F119-PW-100 EMISSIONS OPERATIONS SUMMARY

		Fuel flow,	Average	% Maximum	% Maximum Engine Pressure
· Engine Type	Operation Mode	lbs/hr	lbs/hr Thrust, lbs 1 Thrust 1	Thrust 1	Ratio 1
F119-PW-100	ldle	1,377			
arana any amin'ny amin'ny amin'ny tanàna mandritry amin'ny tanàna mandritry dia 2000.	Approach	2,740	U Yangi Yangi Yangi Matala kati shi sa wasali ma Yan kati a ƙasa ya kati sa s)	
	Intermediate	10,110		111 (M. 111 M. M. M. B. 111 M.	
, senser a senserative addition interview a sense source and a sense interview interview interview of a set of	Military	18,612			oor torindhichog and an an a start of the second start of the seco
	Afterburner	50,170			
1 Not included as part of this report.	is report.				

Test Report Section 6 Revision 2 June 2002 Page 36 of 36

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APPENDIX A

RAW FIELD DATA

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Page of	TENAX Tube Sample Numbers	607									COMMENTS		-																$\hat{}$	m	
Organics	TENAX Tube	5	Set Iwo	Set Inree	Set Five	Set Six	Six Stack Blank			FIRST SECOND	Û	(°C) (°C)	1 19	20						2/									Max Temp Max Temp	21	
Volatile On	Vost 4	0.9947	3	Boro		in Hg Vac)	Set Five Set Six			SAMPLE FIRST			61 1	21 1	1 16	/ / 2	/ /6	× /	1 1/5	9/ /									Max Vac	9	
Method 0030 - Volatile	>					Leak Checks (liters/min @ in Hg Vac)	Set Three Set Four				TEMP (°C)		N14 131	\vdash	132	135	137	138	141	271				•					m / Max Temp	× 1 × 2	
Metho	Meter Box ID	Meter Box Y	Probe ID/Length	Probe Material		Leak Che		ح		S T DGM	G TEMP (°C) 7		53		35			35	9	7 41	 						+		me Avg.Tm	37.121	
	1	MO	-21	27.06	1 27	07	Set One	Initial 0.00 5	Final o.o.			1563.86	1967.30	150.001	1973.5	1976.5	1979.6	1982.0	1984.5		 								la H Total Volume	2 - 23 · C	
	No.	Test Method	!	Baro. Press (in Hg)	Ambient Temp ('F)	Sample Time		Ē	Ē	ETER ORIFICE	Delta H (i		2.1 1	2.1	1.2	2.1	7.2	7.2	1.2	1. 2					 	-			Avg Deita H	1.1	
SHEET	USAF/EQM Run No.		AF Date		LMF119 Ambient F22 Engine Onerator					LOCK: ROTOME	ime)	47 C 4	2-6	1 7	13	17-	17	40	35	27 35	 										
FIELD DATA SHEET	USAF	3214-(F22 F		10			TIME C		0/ 0	1-	10	15	20	25	30	35	40 //2	 		_							とう	
FIEL	Client	W.O.#	Project ID	Mode/Source ID	Samp. Loc. Source		Comments:			TRAVERSE	Ň																				

Page of	TENAX Tube Sample Numbers	VE DATIPIE INUTIDES											COMMENTS	90 .								-										<u> </u>	Mr.	~ ~ ^ /
anics	TENAX T	Set One	Set Two	Set Three	Set Four	Set Five	Set Six				SECOND	EXIT TEMP		(°C)	2 2	7 /	. 0	2/2	202	0~	~ ~	20									May Temn		22	
e Org	I	1	1	1 1			10100				FIRST	EXIT	TEMP	(0°)	61	1)		8	,	~	5	5									Max Temo		19	•
olatil	Vost 4	0.9947	3	Boro			Ing vac)	201 1146		1 10110	,,	VAC	(in Ha)		/	~	\														Max Vac			-
30 - V	٥٨	0.9		ŭ		almin () :-				, DDODF				9.5	143	135	137	146	651	132	147	50						+-			Max Temp		150	
Method 0030 - Volatile Organics	0	` `	ngth	rial .		orke /lite.	Set Two Set Three Set Four Set Find			ž Vič nem "				. Na	53	43	43	44	45	1°2	46	15									Ť,	>		
Meth	Meter Box ID	Meter Box Y	Probe ID/Length	Probe Material		l aak Ci	Set Two			DGM *		TEMP (°C) TEMP (°C)			218																T PVA.	14:375	اح : 7#	
л т	2	030		29.06	KAL VAL	20	Set One	./@r		DRY GAS			(liters)	1784.525	1992.3	1995.2	1998.1	2001.25	2004.55	2007.85	2011.80	2014.720									Total Volume		661- 07	-
								Initial	Final	CRIFICE TO	PRESSURE	Delta H (in H ₂ O)			2.7	2 ./	/. 2	7.2	2 %	7.2	/.3	(.3									Avg Delta 🦌		622-1	
	Run No.	Test Method	Date	Amhiant Tamp /ºE/	Operator	Sample Time				ROTOMETER	SETTING					20	90	17	43	44	45	لاه											·	•
FIELD DAIA SHEE	USAF/EQM	3214-008-040	-	LMF119	F22 Engine						ΤI	time	1 1.11									1231									Ę			
			 							SAMPLE	TIME (min)		o	- v.	Ģ	2 4		7	្ខុន្ត	2	ន្ត	40					T		T	T		マリーク		
	Client W O #	Project ID	Mode/Source ID	Samp. Loc.	Source	(Comments:			IRAVERSE	INIO												•									のい		

FIELD DATA SHEET

Page of			2					1500K					COMMENTS																				1	2
anics	T TENAX 1	Set One	Set Two	Set Three	Set Four	Set Five	Set Six	Stack Blank	·		SECOND	EXIT TEMP		(ວູ)	23	22	12	20	20	20	20	202					 	_	+	-		Max Temp	22	
e Org	D						; ; ;	Set Six			FIRST	EXIT	TEMP	(°C)	18	()	61	()	1	61.	51	6								T		Max Temp	63	
⁷ olatile	Vost 4 ·	0.9947	3	Boro			In Hg Vac)	Set FIVE			SAMPLE	VAC	(in Ha)		1 15-24	/	/	/			~								╞	+		Max Vac		
30 - V	>	0						JNOL JAC							145	148	147	142	146	150	153	153								T		Max Temp	153	
Method 0030 - Volatile Organics	<u> </u>	××	Length	iterial		chocke ///	Set Two Set Throot Set From Set From Set Throot	-				÷.		1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	52	46	42	46	47	Ve	76	76									M		رر ا	
Met	Meter Box ID	Meter Box Y	Probe ID/Length	Probe Material	1	- Lost	Set Two	+		NCK X	INLET	TEMP (°C)			4/2																	Avg	46.17	
	З	M0030	./2.00	9.05	40 1 41	V.O.	Set One	0.00 L	0.002"				(liters)	2017.615	2020.65		2026,6	2029, 5	2032. 1	2035.2	2038.1	2040.770											23.155	
				0				Initial	Final	ORIFICE	PRESSURE	elta H (in H ₂ O			7.2					1.2	1.2	1.2									Aun Dalla U		1.20	
ET	Run No.	Test Method	Date	Baro. Press (in Hg)	Amolent Lemp ('F) Operator	Sample Time				ROTOMETER ^{TS}	TING					4	0,	0/ 0/	35	35	39	35												
FIELD DATA SHEET	USAF/EQM	3214-008-040	- AF	- NAE 440	F22 Engine					CLOCK	TIME (plant	time).	6	1671								1329										Z	BINVITES	
DA1				<u>)</u>						SAMPLE	TIME (min)		C	у и	, ę	2 4	2 6	2	3	3	S S	₽		T									DESKANENSCO	
FIELL	Client	Broinet ID	Mode/Source ID	Samp. I oc	Source		Comments:			TRAVERSE	LNIO			Service Se																			MANAGEHS (

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Pageof		mple Numbers	2									「ないないないないないないない」、 ちょうちょう シー・シックステレント ない			COMMENTS																				74	ノン
anics		TENAX Tube Sample Numbers	Set One / 50/	Set Two	Set Three	Set Four	Set Five	Set Six		1	T		COND.	EXIT TEMP	į	(C)	02	10	10	2 0	02	19	/ 3	/ 5										Max Temp	0	
Method 0030 - Volatile Organics)	.]	[1	!		_	Set Six			E EIDCT				() 	202	61	15	61	5 '	\$ \	5	18										Max Temp	4	
/olati]		Vost 4	0.9947	e	Boro			Leak Checks (liters/min @ in Hg Vac)	Set Five			SAMPI F			(in Ha)		4			/			\	\ 										Max Vac	` 	
30 - 1								ers/min @	El Set Four			PROBE	1				7 / /	15	152	141.	141	135	, 8 5	133				•					,	Max Temp	157	
od 00	ļ	0	7	ength	rial			hecks (lit	Set Three	<u> </u>		™° DGM ``	OUTLET	-		-/	57	5	49	48	47	47	47	20										Avg Tm		
Meth		Meter Box ID		Probe ID/Length	Probe Material			Leak C	Set Two			DGM	INLET	TEMP (°C)			N W												-							1
- -	Ţ	-		. / 2 - 60	5.06	2	44	0	Set One	0.000 2	5.002	DRY GAS	4		(liters)	604-1402	1	1.8402	2050.85	2054.8	2056.7	2059.5	2062.5	2004.85										Total Volume	22.165	
				vi	4	~	×	רא וויי		Initial	Final	ORIFICE	PRESSURE	Delta H (in H ₂ O)		- /	, c	1.1	7.2	1. 2	7.2	1.2	1.2	/ r								-		Avg Delta H	1. 2	
LET				Date	Baro. Press (in Hg)	Ambient Temp (°F)	Operator	Sample Time				ROTOMETER	SETTING			られ		5	35	55	35	40	37	38												
FIELD DATA SHEET	IISAF/FOM	3214 000 040	0+0-000-4-1 70	AF	A	L.S. 19	F22 Engine) TIME (plant	time)	1614									1654										5	a Linut a	1
D DA'					_ ⊇							SAMPLE	POINT TIME (min)		0	S	ę	-	<u>.</u> 8	8	55	g	35	4										VERREY		
FIEL	Client	# C A	Drojact ID		Iniode/Source IL	samp. Loc.	Source		Comments:			TRAVERSE' SAMPLE		NO.																				E MM		

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Method 0030 - Volatile Organics

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	TENAX Tube Sample Numbers	ود ک						15006					COMMENTS									-					
	TENAX Tube	Set One	Set Two	Set Three	Set Four	Set Five	Set Six	Stack Blank			T SECOND			(°C)	20	20	20	15	- 19	- 19	15	19		-			
))			1	1	!		_	Set Six			E FIRST	0	TEMP		61	19	18	21, 2	1 8	15	()	د،					
	Vost 4	0.9947	е С	Boro			n Hg Vac)	Set Five			SAMPLE	TRAIN	(in Ha)		/	/	/	. /)	1	1	/					
-	ž	0					s/min @ i	Set Four Set Five			PROBE	TEMP (°C)			341	142	140	139	139	138	139	139					
	~		ngth	ial	•		Leak Checks (liters/min @ in Hg Vac)	Set Three			DGM	ουτιετ	(C)		وانحر	45	45	44	44	44	44	44	•				
	Meter Box ID	Meter Box Y	Probe ID/Length	Probe Material			Leak Cr	Set Two			DGM	INLET			NA				-								
	7	M0030	. 12.00	25.06		11	101	Set One	0.002	0.002	DRY GAS	METER	(liters)	2067.53	2005.8	2672.1	2074.4	2076.8	2079.1	2051.7	2084 2	2056.49				1	
			9				5		Initial	Final	ORIFICE	PRESSURE			1.2	2.2	1.2	1.2	1. 2	1.2	1. 2	1-2					
	Run No.	Test Method	Date	Baro. Press (in Hg)	Ambient Temp (°F)	Operator	Sample Time				ROTOMETER	SETTING P			4+2-26	30	32	33	34	35	35-	₹ 5 ⁻ [)					
	USAF/EQM	3214-008-040	AF	A	LMF119	F22 Engine					CLOCK	TIME (plant time)		1711								1251					
	Client	#'0'M	Project ID	Mode/Source ID	 Samp. Loc. 	Source		Comments:			TRAVERSE" SAMPLE	POINT TIME (min)		0	S	10	15	50	25	30	35	40					

Marco Services

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61

140

Max Temp Max Vac Max Temp Max Temp

5

Avg Tm 44.375

Total Volume

Avg Delta M

18.56

1.4

Page of		TENAX Tube Sample Numbers	13 0/3						•			うちょう しょうしょう		COMMENTS																				10	l'hr		•
anics		TENAX	Set Une	Set Thron		Set Four						SECOND	EXIT TEMP		(0°)	202	2	, C ,		o b	00		n i	10										Max Temp	20		
0rg	D							Cot Civ	oel oix				EXIT	TEMP	(°C)	81								g										Max Temp	j v	2	
Method 0030 - Volatile Organics		Vost 4	0.3347	Born	2		(Ho Vac)	Cat Find	Del Live			SAMPLE	VAC	(in Ho)		/																	-+	Max Vac		-	
30 - V	:		5	ľ	5		s/min @ ir	Set Four				· PROBE				131	130	~	, ,		25	2		7										Max Temp	137		
00 po		- >	nath .	, ial	•		Leak Checks (liters/min @ in Hn Vac)	Set Three								25	4	25	22	42	17	42	, ,				-						7	7)		
Meth	Mater David	Meter Box IU	Probe ID/Length	Probe Material		_	Leak Cl	Set Two			SC BCB	NLET	1 77			オイ																		Avg Im	0'2'.	1	
-	ę	MDD30	5.12.00	25.06	90	NA -	40	Set One	0.002	5.002				(liters)	2051.705	2054.1	2096.6	2.3202	2101.5	2104.7	2107.4	2/10.5	1112 890	20013//-									+ /		21.175		
			8						Initial	Final	ORIFICE ***	PRESSURE	Delta H (in H ₂ O)			/. ۲	/ 2	1.2	7. 2	1.2	/. 2	1.2	1. 2												1. 2		
JET	Run No.	Test Method	Date	Baro. Press (in Hg)	Ambient Temp (°F)	Operator	Sample Time				ROTOMETER					52	34	36	37	3 7	3 8	38	35														
FIELD DATA SHEET	USAF/EQM	3214-008-040	AF	۷	LMF119	F22 Engine							time)		1805								1546											2	OMEJETANTE		
LAU (_							" SAMPLE	TIME (min)		ļ	0	2	2	15	20	25	ອ	35	40					ŀ		T	T				ONEHICS		
FIELI	Client	W.O.#	Project ID	Mode/Source ID	Samp. Loc.	Source		Comments:			TRAVERSE	POINT	NO.																						MANAGERE		

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| e Sample Numbers | | | | | | | | | COMMENIO

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| TENAX Tub
Set One | | Set Four | Set Five
Set Six | Stack Blank | | | SECOND | EXIT TEMP | [3]

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 | | | Max Temp | 20
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| | | | | Set Six | | | FIRST | EXIT | remp
(°C)

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 | | | Max Temp | 20
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347 | e | 2 | Ha Vac) | Set Five | | | SAMPLE | VAC | (in Ha)

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| 507
56:0 | ľ | 8 | s/min @ in | Set Four | | | PROBE | |

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| | ngth | | ecks (liter | Set Three | | | * DGM | TEMP (°C) |

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 | 38 | 58 | 205 | 38 | 55 | 39

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| Meter Box IC
Meter Box Y | Probe ID/Ler | Prope Maler | Leak Ch | Set Two | | | DGM S | TEMP (°C) |

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 | | _ | Avg 1 | 38.6
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| 0 | -13-00 | 8 | t | Set One | 0.003 | 0.000 2 | 7 | | (liters)
2//6.395

 | 2117.85

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 | 2124.4 | 2/27.5 | 2/30.05 | 2/33.7 | 2136.5 | 2139.500

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 | | + | Total Volume | 24,505
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| | 9 6 | • | | | Initial | Final | ORIFICE " | Delta H (in H ₂ O) |

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 | | | Avg Delta H | 1.20
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| Run No.
Test Method | Date | Ambient Terr | Sample Time | | • | | ROTOMETER | |

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| USAF/EQM
3214-008-040 | AF | LMF119 | | | | | Ö
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| Client
W.O.# | oject ID
ode/Source ID | Samp. Loc. | | omments: | | | RAVERSE ⁷ SAMPLE
POINT TIME (min | No. | 0

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 | | - | | アークション
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| | USAF/EQM Run No. 1 Meter Box ID Vost 4 TENAX 1 3214-008-040 Test Method M0030 Meter Box Y 0.9947 Set One | USAF/EQM Run No. 1 Meter Box ID Vost 4 3214-008-040 Test Method M0030 Meter Box Y 0.9947 Set ID AF Date 9.73-04 Probe ID/Length 3 Set | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | USAF/EQM Run No. 1 Meter Box ID Vost 4 ID 3214-008-040 Test Method Moo30 Meter Box V 0.9947 Set Source ID AF Date \$7.3^{-}.5^{-}.04 Probe ID/Length 0.9947 Set Source ID N Baro. Press (in Hg) \$7.3^{-}.6^{-}.5^{-}.04 Probe ID/Length Boro Set Loc. LMF119 Ambient Temp (°F) \$67.5^{-}.5^{-}.04 Probe Material Boro Set Loc. F22 Engine Operator \$67.5^{-}.5^{-}.5^{-}.04 Probe Material Boro Set Sample Time \$61.5^{-}.5 | USAFEQM Run No. 1 Meter Box ID Vost 4 D AF Test Method M0030 Meter Box Y 0.9947 Set 0:0 AF Date Probe ID/Length 0.9947 Set 0:0 AF Date Probe ID/Length 3 Set 0:0 Image: | USAFEQM Run No. 1 Meter Box ID Vost 4 3214-008-040 Test Method M0030 Meter Box V 0.9947 Set 3214-008-040 Test Method M0030 Meter Box V 0.9947 Set N Baro. Press (in Hg) 7.3.00 Probe ID/Length 3 Set .oc. LMF119 Ambient Temp (°F) 7.5.7 Probe Material Boro Set .oc. F22 Engine Operator Operator Set Set Set .oc. F22 Engine Operator Set One Set One Set Two Set Four Set Set .oc. F22 Engine Operator Set One Set One Set Four Set Four Set Four Set Set | USAFEQM Run No. 1 Meter Box ID Vost 4 3214-008-040 Test Method Test Method M0030 Meter Box Y 0.9947 Set 3214-008-040 Test Method Test Method Probe ID/Length 0.9947 Set Source ID N Baro. Press (in Hg) Z.5.57 Probe ID/Length Boro Set Source ID N Baro. Press (in Hg) Z.5.57 Probe Material Boro Set Soc. LMF119 Ambient Temp (°F) % Probe Material Boro Set Soc. Figale Operator Set Two Set Two Set Two Set Two Set Set Initial Set One Set Two Set Two Set Two Set Four Set Set Set Set | USAFEGM Run No. 1 Meter Box ID Vost 4 D AF Date M0030 Meter Box Y 0.9947 Set Nource ID N Baro. Press (in Hg) Y.3. J. J. Probe ID/Length 0.9947 Set Nource ID N Baro. Press (in Hg) Y.3. J. J. Probe ID/Length 0.9947 Set Oc. LMF119 Ambient Temp (°F) Y.3. J. J. Probe Material Boro Set Oc. F22 Engine Operator Y.3. J. J. Probe Material Boro Set Ambient Temp (°F) Ambient Temp (°F) R.A. Probe Material Boro Set Ambient Temp (°F) Final Set One Set Two Set Two Set Set Set Ambient Time One Set Two Set Two Set Two Set | USAFEOMRun No.1Meter Box IDVost 4TENAX Tube SampleDAFDateTest MethodM0030Meter Box Y0.9947Set OneJonoSource IDAFDateMo030Meter Box Y0.9947Set OneJonoSource IDNBaro Press (in Hg)Tobe ID/LengthBoroSet OneJonoCo.LMF119Ambient Temp (F)Tobe MaterialBoroSet TreeSet TreeCo.LMF119Ambient Temp (F)Tobe MaterialBoroSet TreeSet TreeCo.LMF119Ambient Temp (F)Tobe MaterialBoroSet TreeSet TreeCo.LMF119Ambient Temp (F)Tobe MaterialBoroSet TreeSet TreeCo.F22 EngineOperatorSet OneSet TreeSet FiveSet SixAfterSampleCo.Leak Checks (liters/min @ in Hg Vac)Set SixSet SixFinal2.400Set TreeSet TreeSet SixSet SixAfterSet TreeSet TreeSet TreeSet SixSet SixAfter <td>USAFFEOM Run No. 1 Meter Box ID Vost 4 D AF 2314-008-040 Test Method M0030 Meter Box Y 0.9947 Set Dource ID N Baro. Press (in Hg) No Test Method M0030 Meter Box Y 0.9947 Set Cource ID L N Baro. Press (in Hg) Test Method Test Method Test Method Set co. L L Baro. Press (in Hg) Zi<i< td=""> Zi Probe ID/Length 0 Set co. E22 Engine Operator Operator Zi Leak Checks (liters/min @ in Hg Vac) Set co. E22 Engine Operator Leak Checks (liters/min @ in Hg Vac) Set Set co. E1 Detation Set One Set One Set Time Set Set rents: Set One Set One Set Time Set Five Set Six final D.c. Leak Checks (liters/min @ in Hg Vac) Set Six Set final D.c. Set Time Set Time Set Six Set final D.c. Set One Set Time Set Five Set Six Set final D.c. Set One Set Time<td>USAFEOM Run No. 1 Meter Box Y Vost 4 TENAX Tube Sample D AF Date 3214-008-040 Test Method Motors ID Vost 4 TENAX Tube Sample Nource ID N Baro. Press (in Hg) Motors 10 Motors 10 Set Two Set Two .o LINF 119 Ambient Temp (F) 27.77 Probe Material Boro Set Two Set Two .o E22 Engine Operator 27.77 Probe Material Boro Set Two Set Two Set Two Set Two Set Two Set Two Set Six Set Six<td>USAFECM Run No. 1 Meter Box ID Vost 4 TENAX Tube Sample Date 3214-008-040 Test Method Meter Box V 0.9947 Set One X-X-V.2 Douce ID N Baro. Press (in Hg) No030 Meter Box V 0.9947 Set One X-X-V.2 Nource ID N Baro. Press (in Hg) X-7-Y Probe IDLength Boro Set Two Set One .0. LUMF119 Ambient Temp (*P) X-7-Y Probe Material Boro Set Two Set Two Set Two Set Six .0. F22 Engine Operator X-7-Y Probe Material Boro Set Six Set Six .0. F22 Engine Operator X-7-Y Set Two Set Six Set Six Set Six .0.1 Miter Boro Set Two Set Two Set Six Set Six Set Six Set Six .0.1 Miter Boro Set Two Set Two Set Six Set Six Set Six Set Six Set Six Set Six Set</td><td>$\begin{array}{ c c c c c c c c c c c c c c c c c c c$</td><td>USAFECM
USAFECMRun No.USAFECM
USAFECMRun No.Meter Box ID
Amer Box VVost 4TENAX Tube Sample2314-006-040Test MethodMotoralMeter Box V0.9947Set OneSet OneAFDateDateProbe IDLength0.9947Set OneSet OneNo.LINF119Ambient Temp (*)7.3.47Probe IDLengthBoroSet One0.0.LINF119Ambient Temp (*)7.3.47Probe MaterialBoroSet One0.1LINF119Ambient Temp (*)7.3.47Probe MaterialBoroSet Five0.1Line 1Sample TimeSet OneSet OneSet FiveSet Set Set Set Set Set Set Set Set Set</td><td>$\begin{array}{ c c c c c c c c c c c c c c c c c c c$</td><td>USAFECIM Run No. Image: State of the st</td><td>USAFFEOM Run No. I Meter Box ID Visit 4 TENAX Tube Sample 2314-006-040 Test Wethod Monton Itest Wethod Monton Set Two Set Six <td< td=""><td>UGAFEOM Run No. Image Image</td><td>USAFECIM Fun No. Image: Constrained state Image: Constrained state Image: Constrained state Image: Constrained state Image: Constraine state Image: Constastane state <th< td=""><td>UGAFECIM Run No. Image: Field Section of the Box V Vosit A TENAX Tube Sample 00uce ID Ar Baro. Press (in Hg) Meter Box V 0947 Set from of the Sample 00uce ID Ar Baro. Press (in Hg) Anbient Tenno (*) Anbient Tenno (*) 23.7.7 Prose IDL engin Baro. Press (in Hg) Set from of the Sample 00uce ID IMF119 Ambient Tenno (*) 23.7.7 Prose Release (in Hg) 23.7.7 Set from of the Sample Set from of the Sample 00uce ID IMF119 Ambient Tenno (*) 23.7.7 Leak Checks (illers/min @ in Hg vac) Set from of the Sample 00uce ID IMF119 Ambient Tenno (*) Set from of the Sample Set from of the Sample 1 IMF119 Ambient Tenno (*) Each One Set from of the Sample Set from of the Sample 0 I///5 Ambient Tenno (*) Each One Set from of the Sample Set from of the Sample 1 Immediation Tenno Set from of the Sample Each One Set from of the Sample Set from of the Sample 1 Immediation Tenno</td><td>USAFEGM Run No. Image Image Vost Vost TENX TUBe Sample 00rce ID N Noncol Noncol<td>$\begin{array}{ c c c c c c c c c c c c c c c c c c c$</td><td>USAFEGM Run No. LukerEdM Run No. Image Notest Exx V Vest A TENX Tube Sample 0ucce ID N N Notest Exx V 0947 Set One Set One 0ucce ID N Notest Exx V 0947 Set One Set One 0ucce ID Lucr119 Ambient Texm (Tr) Probe Intered K Probe Intered K Set One 0ucce ID Lucr119 Ambient Texm (Tr) Probe Intered K Probe Intered K Set One Set One 0 Lucr119 Ambient Texm (Tr) East Tow Set (Intered K) Set Tow Set (Intered K) S</td><td>USAFECM Run No. 1 Meter Elox V Voart 4 TENX Tube Sample 0 X 2314-008-00 Test Metrod More IR box V 0947 Set for Set for 0.ucce ID N Bao. Press (in Hy) More IN test Box V 0947 Set for Set for 0.ucce ID N Bao. Press (in Hy) 27.7 Probe INtending Bao. Press (in Hy) 27.7 Set for <td< td=""><td>USAFECM Fan No. Meter Box V Voat 4 TENAY Tube Sample 00 231-003-00 Test Metrod Test Metrod</td><td>Dispection Run No. Instruction Text Matrix <t< td=""><td>USAFECIM
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INCODE Run No. Instruction Text Metric Scr. <t< td=""><td>UberFactor Run No. 1 Meer Box V Veet A TENX Tube Sample 0 3214-030-040 Test Matrical Meer Box V 294/1 Set Two Set Two</td><td>$\begin{array}{c} \begin{array}{c} \hline \mbox{USAFECM} & \mbox{FGM} &$</td><td>USE-FEOM Fain No. USE-FEOM Fain No. Ear No.</td><td>Luckreton Ban No. Ment Ban D. <th< td=""><td>Interfacion Interfaction Interfaction<!--</td--></td></th<></td></t<></td></t<></td></td<></td></td></th<> | UGAFECIM Run No. Image: Field Section of the Box V Vosit A TENAX Tube Sample 00uce ID Ar Baro. Press (in Hg) Meter Box V 0947 Set from of the Sample 00uce ID Ar Baro. Press (in Hg) Anbient Tenno (*) Anbient Tenno (*) 23.7.7 Prose IDL engin Baro. Press (in Hg) Set from of the Sample 00uce ID IMF119 Ambient Tenno (*) 23.7.7 Prose Release (in Hg) 23.7.7 Set from of the Sample Set from of the Sample 00uce ID IMF119 Ambient Tenno (*) 23.7.7 Leak Checks (illers/min @ in Hg vac) Set from of the Sample 00uce ID IMF119 Ambient Tenno (*) Set from of the Sample Set from of the Sample 1 IMF119 Ambient Tenno (*) Each One Set from of the Sample Set from of the Sample 0 I///5 Ambient Tenno (*) Each One Set from of the Sample Set from of the Sample 1 Immediation Tenno Set from of the Sample Each One Set from of the Sample Set from of the Sample 1 Immediation Tenno | USAFEGM Run No. Image Image Vost Vost TENX TUBe Sample 00rce ID N Noncol Noncol <td>$\begin{array}{ c c c c c c c c c c c c c c c c c c c$</td> <td>USAFEGM Run No. LukerEdM Run No. Image Notest Exx V Vest A TENX Tube Sample 0ucce ID N N Notest Exx V 0947 Set One Set One 0ucce ID N Notest Exx V 0947 Set One Set One 0ucce ID Lucr119 Ambient Texm (Tr) Probe Intered K Probe Intered K Set One 0ucce ID Lucr119 Ambient Texm (Tr) Probe Intered K Probe Intered K Set One Set One 0 Lucr119 Ambient Texm (Tr) East Tow Set (Intered K) Set Tow Set (Intered K) S</td> <td>USAFECM Run No. 1 Meter Elox V Voart 4 TENX Tube Sample 0 X 2314-008-00 Test Metrod More IR box V 0947 Set for Set for 0.ucce ID N Bao. Press (in Hy) More IN test Box V 0947 Set for Set for 0.ucce ID N Bao. Press (in Hy) 27.7 Probe INtending Bao. Press (in Hy) 27.7 Set for <td< td=""><td>USAFECM Fan No. Meter Box V Voat 4 TENAY Tube Sample 00 231-003-00 Test Metrod Test Metrod</td><td>Dispection Run No. Instruction Text Matrix <t< td=""><td>USAFECIM
INCODE Run No. Instruction Text Metric Scr. <t< td=""><td>UberFactor Run No. 1 Meer Box V Veet A TENX Tube Sample 0 3214-030-040 Test Matrical Meer Box V 294/1 Set Two Set Two</td><td>$\begin{array}{c} \begin{array}{c} \hline \mbox{USAFECM} & \mbox{FGM} &$</td><td>USE-FEOM Fain No. USE-FEOM Fain No. Ear No.</td><td>Luckreton Ban No. Ment Ban D. <th< td=""><td>Interfacion Interfaction Interfaction<!--</td--></td></th<></td></t<></td></t<></td></td<></td> | $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$ | USAFEGM Run No. LukerEdM Run No. Image Notest Exx V Vest A TENX Tube Sample 0ucce ID N N Notest Exx V 0947 Set One Set One 0ucce ID N Notest Exx V 0947 Set One Set One 0ucce ID Lucr119 Ambient Texm (Tr) Probe Intered K Probe Intered K Set One 0ucce ID Lucr119 Ambient Texm (Tr) Probe Intered K Probe Intered K Set One Set One 0 Lucr119 Ambient Texm (Tr) East Tow Set (Intered K) Set Tow Set (Intered K) S | USAFECM Run No. 1 Meter Elox V Voart 4 TENX Tube Sample 0 X 2314-008-00 Test Metrod More IR box V 0947 Set for Set for 0.ucce ID N Bao. Press (in Hy) More IN test Box V 0947 Set for Set for 0.ucce ID N Bao. Press (in Hy) 27.7 Probe INtending Bao. Press (in Hy) 27.7 Set for Set for <td< td=""><td>USAFECM Fan No. Meter Box V Voat 4 TENAY Tube Sample 00 231-003-00 Test Metrod Test Metrod</td><td>Dispection Run No. Instruction Text Matrix <t< td=""><td>USAFECIM
INCODE Run No. Instruction Text Metric Scr. <t< td=""><td>UberFactor Run No. 1 Meer Box V Veet A TENX Tube Sample 0 3214-030-040 Test Matrical Meer Box V 294/1 Set Two Set Two</td><td>$\begin{array}{c} \begin{array}{c} \hline \mbox{USAFECM} & \mbox{FGM} &$</td><td>USE-FEOM Fain No. USE-FEOM Fain No. Ear No.</td><td>Luckreton Ban No. Ment Ban D. <th< td=""><td>Interfacion Interfaction Interfaction<!--</td--></td></th<></td></t<></td></t<></td></td<> | USAFECM Fan No. Meter Box V Voat 4 TENAY Tube Sample 00 231-003-00 Test Metrod Test Metrod | Dispection Run No. Instruction Text Matrix Text Matrix <t< td=""><td>USAFECIM
INCODE Run No. Instruction Text Metric Scr. <t< td=""><td>UberFactor Run No. 1 Meer Box V Veet A TENX Tube Sample 0 3214-030-040 Test Matrical Meer Box V 294/1 Set Two Set Two</td><td>$\begin{array}{c} \begin{array}{c} \hline \mbox{USAFECM} & \mbox{FGM} &$</td><td>USE-FEOM Fain No. USE-FEOM Fain No. Ear No.</td><td>Luckreton Ban No. Ment Ban D. <th< td=""><td>Interfacion Interfaction Interfaction<!--</td--></td></th<></td></t<></td></t<> | USAFECIM
INCODE Run No. Instruction Text Metric Scr. Text Metric Scr. <t< td=""><td>UberFactor Run No. 1 Meer Box V Veet A TENX Tube Sample 0 3214-030-040 Test Matrical Meer Box V 294/1 Set Two Set Two</td><td>$\begin{array}{c} \begin{array}{c} \hline \mbox{USAFECM} & \mbox{FGM} &$</td><td>USE-FEOM Fain No. USE-FEOM Fain No. Ear No.</td><td>Luckreton Ban No. Ment Ban D. <th< td=""><td>Interfacion Interfaction Interfaction<!--</td--></td></th<></td></t<> | UberFactor Run No. 1 Meer Box V Veet A TENX Tube Sample 0 3214-030-040 Test Matrical Meer Box V 294/1 Set Two Set Two | $ \begin{array}{c} \begin{array}{c} \hline \mbox{USAFECM} & \mbox{FGM} &$ | USE-FEOM Fain No. Ear No. | Luckreton Ban No. Ment Ban D. Ment Ban D. <th< td=""><td>Interfacion Interfaction Interfaction<!--</td--></td></th<> | Interfacion Interfaction Interfaction </td |

Page		ו בואאל ו ude Sample Numbers	1/20				<i>Kol</i> 1						COMMENTS										 								1	
ganics				Set Three	Set Four	Set Five Set Siv	Stack Blank		T	1	D. COND.			2	+	200	202	20	6'	201		5								Max Temp	*× 0 •	
atile Or	-		e			(Jac)	Set Five Set Six	┢			TRAIN COND.		(in Ha) TEMF			01		0		0	, v , , , , , , , , , , , , , , , , , ,							_		Max Vac Max Temp	<u> </u>	
30 - Vol	Mant 4	U31 4		Boro		ers/min @ in Ha	Set Four Set			PRORE CA	~			120	22/	130	(1)) < 2	251	13 8	35	021								Max Temp Max	1 2.71	
Method 0030 - Volatile Organics	Mater Boy ID	Meter Box Y	Probe ID/Length	Probe Material		Leak Checks (liters/min @ in Ho Vac)	Set Two Set Three			DGM 🦾 DGM		TEMP (°C) TEMP (°C)		975	\$	5	42	12	77	1/>	2/2									MT BVA	<u>-</u> 87	
Ι	2	M0030	0	8-57 P	400	05	Set One	e.C @ r	0.002			READING	2/45.700	2146.2	2/49.5	2152.1	2154.7	2157.5	2/60.00	2162.5	2165.470									Total Volume	21.77	-
			2	in Hg) Z	p ('F)			Initial	Final	ORIFICE	PRESSURE	ueita H (in H₂O)		1.2		1.2	/. 2	1.2			/ 2									Avg Delta H	1.20	
ET	Run No.	Test Method	Date	Baro. Press (in Hg)	Ambient i emp ("F) Operator	Sample Time				R	SETTING			35	57	38	37	36	36	36	37											
FIELD DATA SHEET	USAF/EQM	3214-008-040	AF	z	F22 Engine						1) TIME (plant time)		1215								1256									54		ł
LD DA		ľ	Project ID				lellis.				AI IME (min) L		0	5	₽	15	8	25	8	35	40					_	 -			 VERICE V	パーシー	
FIF	Client	#:0.W	Project ID	Samo Loc	Source		COULDENIES.			IKAVERSE	NO.	.	÷																	<pre>S</pre>	MANAGE	

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Pageof	TENAX Tube Sample Numbers												COMMENTS									706 E/Mil.											<u>ک</u> ک
nics	TENAX TU	Set One		Set Three	Set Four	Set Five	Set Six	Stack Blank			SECOND	COND.		(°C)	07	61	51	18	61	5/	19	51										Max Temp	0
0rg								Set Six			FIRST	COND.	TEMP	(ລູ)	17	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	2	>	6	13	é	1										emp	- 20
Volatile Organics	Vost 4	0.9947	e	Boro		·	Hg Vac)	Set Five			SAMPLE	TRAIN	(in Ha)		/	\			-								T					Max Vac	
	Ň	60		٦ ۵			s/min @ in	Set Four			"PROBE"	TEMP (°C)			147	146	136	133	134	152	136	143										Max Temp	ーレゲ
Method 0030 -	Q		ength .	erial .	•		Leak Checks (liters/min @ in Hg Vac)	Set Three			NDG N				\$ \$	3 7	36	35	3 2	58.	2	53				·					F		
Metł	MeteCBox ID	Meter Box Y	- Probe ID/Length	Probe Material	1		Leak C	Set Two			DGM																					AIC.	- F
	4	M0030	9.14.00	7.54	84	4	Q	Set One	0.004	2000	DRY GAS	METER	(liters)	2168.065	2/71.5	2174.5	2177.2	2180.24	2183.3	2185.9	2188.7	2191.172								-		a .	(3. /0)
						P	7		Initial	Final	ETER ORIFICE	PRESSURE Delta H (in H _s O)			1-2	1.2	1.2	1.2	1.2	1.2	/. Z	1.2									'	Avg Delta	
LET	Run No.	Test Method	Date	Baro. Press (in Hg)	Ambient Temp (°F)	Operator	Sample Time					SELLING			14/ = 38	07	60	40	41	77	37	38											
FIELD DATA SHEET	USAF/EQM	3214-008-040	AF	¥	LMF119	F22 Engine						n) illuic (plant (time)		1035	-7							111-111	1/22										
D DA				D S				S.			SAMPLE			0	2	₽	15	20	25	8	35	9							-			N MAR	ł
FIEI E	Client	W.O.#	Project ID	Mode/Source ID	Samp. Loc.	Source	Ċ	Comments:			TRAVERS	N.										-											

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FIFI D DATA SHEFT

Page	N N N		COMMENTS			
anics	TENAX T Set One Set Two Set Three Set Four Set Five	Stack Blank	SECOND COND. EXIT TEMP (°C) 20	0 0 0 0	5 2 2	Max Temp
Org:)	Set Six	FIRST COND. EXIT TEMP (°C)	07 02 0	6	Max Temp Max Temp
olatile	70 33	Hg Vac) Set Five	SAMPLE TRAIN VAC (in Ha)	~ ~ ~ ~		Max Vac
30 - Vo	Vost 4 0.9947 Boro	s/min @ in Hg Vac Set Four Set Five	rtemp (°c) רבאף (°c) רץ ר	135	43-143	Мах Тетр / 4 7
Method 0030 - Volatile Organics	Meter Box ID Meter Box Y Probe ID/Length Probe Material	Leak Checks (liters/min @ in Hg Vac) Set Two Set Three Set Four Set Five	DGM CERT DGM INLET OUTLET TEMP (°C) TEMP (°C)	to to be an		W WI BAN
L	2 M0030 5.54	Set One	DRY GAS METER METER READING (Ilitors) 2/92.5	2159.6 2205.5 2205.5	22/4.500	Total Volume
			PRESSURE PRESSURE Delta H (in H ₂ O)	1.1 1.1	2·/	Avg Delta H
ET	Run No. Test Method Date Baro. Press (in Hg) Ambient Temp (°F) Samole Time		ROTOMETER SETTING	42 40 40	39 40	
LD DATA SHEET	USAF/EQM 3214-008-040 AF M LMF119 F22 Engine	č.	CLOCK CLOCK (plant time) (time)		<u>علمه ا</u>	
D DAT			POINT TIME (min) NO. NO. S	20 25 25	6 33 3	
FIELI	Client W.O.# Project ID Mode/Source ID Samp. Loc. Source	Comments:	POINT POINT			

			ł	1		1	ł	1	1 1	I	2003000	2.64.95.65						<u> </u>		- T-							.	 1 1	 - <u></u>		 1			
	ł		Final	3	yes no	yes / no	Post-Test Set		Pass / Fail	yes / no	COMMENTS																					1	-Um	~
	Page / of /	K Factor 311. 9625	Mid-Point		yes / no	s / no yes / no	est Set		Pass / Fail	yes / no																						Max Temp		
	A A A	K Factor	Initial	いたい	yes / no	All 10	Pre-1		Pass	yes.	SAMPLE TRAIN VAC		5	8	δ	L	5	n		4	γ	s/	S	h								Max Vac S		
641	*		cks in (f ³)	@ (in Hg)			ck	emp Femp	/- 2°)	Temp Change Response	IMPINGER		68	(e /	59	64	68	89.	6	60	9.	90	67	68								Max Temp 6 8	included	
.£	ılate	-1	Leak Checks	Leak Check @ (in Hg)	Pitot good	Orsat good	Temp Check	Meter Box Temp Reference Temp	Pass/Fail (+/- 2 ⁰)	Temp Chan	FILTER BOX TEMP		250	248	878	248	8+2	2 4 4 2	248	877	222	C72	148	248				_	_			Min/Max 250	does not have noter tomo or stark femo included	
•	_	2 WC 17	7925	Boro		0.84	C D L	~~	60	-	2		245	229	236	238	237	2.54	15.7	F17		52	246	244								Min/Max 229 /247	to amo t	
	5/202 -		yred	_				0						6	45	2	13	20	22			+ (55	22	_				_			ν _α τα∕ Υ	had moter	ch point.
	EPA Method	۵ ۲	Del H encth	rial	Pitot / Thermocouple ID	cient-	Uin (in)	ck (ft ²)	e e	rse Pts	新。 我们) TEMP (°F)	16	6		75	22	<u>}</u>			7		55	74								Avg T@/ 93.05	docs not	iput at e
	EPA]	Meter Box ID Meter Box Y	Meter Box Del H Probe ID / Length	Probe Material	Pitot / Therr	Pitot Coefficient-	Avo Nozzle ID	Area of Stack (ft ²)	Sample Time	Total Traverse Pts	R STACK	TEMP ('F)	130	138	140	2	241	~					<u> </u>	1						-		Avg Ts ^V	K-factor	These are input at each point
	-	Actual				19. A. S.					DRY GAS METE READING (ft ³)	20L-82	633.5	مع. ۲	n.	Ż	1	658.3	d.	àr	nl.	- I.	ا ئە	085.219								rotal Volume 5억 , 51구	Comments: +	,
	r	Stack Conditions Assumed	2		5.0	20.5	44	-0.02	C	- 2	ORIFICE DR PRESSURE F	H2O)	5			20		010				-		7									н	
•	SHEET	Stack	% Moisture Impinger Vot (ml)	el (g)	by Vol	y Vol	l emperature ('F) Meter Temp (°F)	Static Press (in H ₂ O)	ĺ	Ambient Lemp ("F)			56	3.8	2.8	2.0		15	- C	4 20 1		; ;	i. 20	2.2	-	-					Ħ	-		
-	DATA	g	% Moisture Impinger Vr	Silica gel (g)	CO2, % by Vol	02, % by Vol	1			Amoleni	VELOCITY PRESSURE Delta		00	0.0	ہَ 0.0	5	6.0	0		0 7 0 7	5	5	0,0	0.0								Avg Sqrt Delta	0-10 01.1	
	FIELD	USAF/EQM 20054.006.001.2000	- AF	LMF119		M202	F119-PW-10	12-Sep-00	29.06	NAT	CLOCK TIME (plant time)	1031	ipyd	6401	102	1054	1	1184	411	11 14	167	11 64	1154	1139										
مريد و	ISOKINETIC FIELD DATA SHEET	2005	0				Idie			Ĭ	SAMPLE TIME (min)	_	4	0			57	0	2	ç 4	1	<u>, </u>	\$	60										
	ISOKI	Client W.O.#	Project ID Mode/Source ID	Samp. Loc. ID	Run No.ID	i est Method ID	Date ID Source/Location	Sample Date	Baro. Press (in Hg)	operator	TRAVERSE	NO	-	-										•										

					4		Τī	[1	1					 T-T-	.		-11		
	Final	Post-Test Set	Pass / Fail yes / no	COMMENTS	* Bad thorner do							-								N	
	Page l of d 3.04.4048 Mid-Point	Y no yes / no / no yes / no Pre-Test Set	Pass / Fail yes / no	* * *	T															Max Temp	
- -		yes / no Pre-1		SAMPLE TRAIN VAC (in Hg)	5	2	5	5,S	2.2	5	<u>ь</u>	5	1	<i>с.</i> с						Max Vac	
6 115 6t	:ks in (ft³) @ (in Hg)	emp emp	Pass/Fail (+/- 2 ⁻) Temp Change Response	r IMPING EXIT TEMP (°F)	* 1			22		61	19	25	1- 90	9						Max Temp 62	
5	ate Leak Samp	Pitot good Orsat good Temp Check Meter Box Temp	Fass/Fail (+/- 2) Temp Change R	FILTER BOX TEMP (F)	253	322	256	252	257	255	152	222		200						Ninmax 257450	•
	Particulate	0.04	8 -	PROBE TEMP (°F)	229	266	273	97	238	243	250	245	201	5						Min/Max 23 3 23 3	
		Ő			¥83	86	89	90	15	92	26	22	62	2					N	8.	
	EPA Method 5/202 Meter Box ID Meter Box Y Meter Box Del H Probe ID / Length Probe Material	couple IJ int ia (in) (tt ²)	e Pts	DGM INLET TEMP (°F)	<u>x</u> x	88 88	68	40	16	76	26	74	67					ĺ		Avg Tm 90.33	
	EPA Met Meter Box ID Meter Box Y Meter Box Del H Probe ID / Length Probe Material	Pitot Coefficient Pitot Coefficient Nozzle ID Avg Nozzle Dia (in) Area of Stack (ft ²) Samula Timo	Total Traverse Pts	F	<u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u>	145		11	146	146	1.71	97 7	1							Avg Ts My S, yl	-#
	ions Ted Actual			dry gas meti Reading (h ³ 472,528	497.520	507.2	5121	573.6	528.7	533.6	1.850	242.4	553.302							Total Volume 60.817 Comments:	
	(m) Assumed		1p (°F)	P	2,83	2.83	91-2	5.52	71-2	11.2	1.1.6	5-10	2.78							Avg Delta H S. O (417 Avg Sqrt Del H	
	ISOKINETIC FIELD DATA SHEET Client USAF/EQM Stack Client USAF/EQM Stack Client USAF/EQM Stack N.O.# ZOD54.006.001.2000 Stack Project ID AF % Moisture Mode/Source ID I Impinger Vol (m) Zun No.ID Z CO2. % by Vol		Ambient Temp (°F)	PRE	0.01	D 'd	0.0	0.02	0.0	10.0	000	10.0	10,0							Avg Sqr Della P B. OTOPS	4-01-0
	C FIELD L USAF/EQM 20054.006.001.2000 AF LMF119 2	M202 12SEP2000 3 F119-PW-100 12-Sep-00	کابر	CLOCK TIME (plant time)	1155	1200	1210	1215	12 20	(12)	1270	1240	1245								ŧ.
		Þ	. staard	SAMPLE TIME (min) 0	(0)	22	25	۰ <u>۲</u>	ير آلر	23	re,	2	90							WEDD	MIRSWORK,
	ISOKIN Client W.O.# Project ID Mode/Source ID Samp. Loc. ID Run No.ID	Test Method ID. Date ID Source/Location Sample Date Baro. Press (in Hg)	Operator	TRAVERSE POINT NO.																STATE OF STATE	

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						,			,	,	Million Charges of a rate						<u> </u>								 	 		 						
	- [Я	Yes Yes I	Post-Test			Pass / Fail	ě.			Sun or		Nut coverect	run 3	Thermeringle	ret respondence	-			-										, , , , , , , , , , , , , , , , , , ,	V/h~	
	Page _ of	311,9685			yes / no	Pre-Test Set			Pass / Fail	/ no	** • • • •		+				*															Max Temp		
		K Factor	8.0	S	Ves no	ย				, yes /		(in Hg)	Ņ	m	3.5	3.5	3.5	S M	35	3. S	3.5	3.5	5	35								Max Vac 3. Sac		
5 HEr 639		-	icks ain (ft ³)	Leak Check @ (in Hg)		sck	Temp	Temp	+/- 2 ⁰)	Temp Change Response		([°] F)	¥	┢──	4	+68	r +	+63	+ 69	+ 69	+ 69	89+	+ 67	+ 67								Max Temp	•	
ί τ	ulate		Sample Train (ft ³)	Leak Checl	Pitot good	Temp Check	Meter Box Temp		Pass/Fail (+/- 2 ⁰)	Temp Char	FILTER		250				248			246	348	848	248	248								Min/Max 24/329		
٣	- Particulate	9895	4	Boro	180	40.0	0.743	4	60	-	PROBE	-) TEMP (°F)	205	622	239	243	243	242	547	245	244	245	244	84S		 		``		\downarrow		Min/Max 202/247		
	5/202	0-	- 1				0				ET DGM		90	0	52	76	93	74	95	96	96	16	98	99	 	 _					/ '	Gyinc Gyinz		·
	EPA Method		Length	erial	Pitot / Thermocouple ID Ditot Coefficient		: Dia (in)	ck (ft²)	Ie	rse Pts	DGM INLET) TEMP (°F)	90)	5	26	26	53	25	77	96	96	26	96	99		 								
× .	EPA]		Probe ID A ength	Probe Material	Pitot / Thermoco		Avg Nozzle Dia (in)	Area of Stack (ft ²)	Sample Time	Total Traverse Pts	R STACK	TEMP (°F)	128		148	341	146	97	146	Ę	147	148	149	<u>ک</u>			-					146, 53		
	ú	Actual				12. 12 Marca			(21-	DRY GAS METE	1167 0.09	52,090	699.0	703.9	708.8	7(3.8	718.7	723.6	1.821	ط.133	738.6	743.6	748.557								Total Volume 59.925	Comments:	
	EET Stack Conditions	Assumed			201	9 <u>+</u>]	• . •	20) - 0.02			· O	Delta H (in H2O)	2.83		-	Z.83	2.85	_		2.86	2.86	2.86	286	286								Avg DeltaW	lõ	0740
	ISOKINETIC FIELD DATA SHEET		Impinger Vol (ml)	Silica gel (g)	CO2, % by Vol	Temperature (°F)		Static Press (in H ₂ O)		Ambient temp ("F)		P (In H2O) De	Ū. Đ	100	0.01	100	0.01	_	10.	10.0	-	0.01	10.0	10.0								H C	0. 10040 AV	=
	FIELD I	20054.006.001.2000	2 -	LMF119	3 M202	12SEP2000	F119-PW-100	12-Sep-00	21.06	YM2				1302	1307	1312	1317	(322	(327	1332	1337	1342	1347	1352					-				1	STW
	NETIC	500					on idle		и нд)		SAMPLE SAMPLE TIME (min)				·ح ا	2	22	30	3	40	27	ß	પ્ર	60									NANGN'	DESCRETCONETIN
	ISOKI	W.O.# Proinct ID	Mode/Source ID	Samp. Loc. ID	Test Method ID	Date ID	Source/Location	Sample Date	baro. Press (in Hg)	Operator	TRAVERSE	NO																					やブン	/ munders

EPA Method 5/202 - Particulate

Client		USAF/	EQM	_	W.O. #		20054.00	06.001.2000		
Location/Pl	ant	Lockheed M	Martin GA	Source	e & Location	n		19-PW-100		
Run No. Sample I.D.		119 - 1 - M202 -	- 12SEP2000	-	Sample Date Analyst	e <u>12-Sep-00</u>	•		ery Date ' Number	7/12/00 641
			·····		Imping	jer				
Contents	1 Di H20	2	3 C	4	5	6	7	Imp.Total		Total
		Di H20				· · · · ·				
Final	84_	113	101					_	314.7	·
Initial	100	100	(00)						300	
Gain	-16	13	1					-2	14.7	12.7
Impinger Col	or 🤇	Clean	74	DI Rin-	Labeled?	yes				
Silica Gel Co	ndition	1/2 spect		3 DCM R-L	Sealed?	1.04		······································		-
						gu				
Run No.	2			:	Sample Date	2 12-Sep-00		Recove	ery Date	9/12/00
Sample I.D.	AF - I - LMF1	19 - 2 - M202 -	12SEP2000		Analyst	PAR			lumber	640
				<u> </u>	Imping	er				<u> </u>
	1	2	3 (2)	4	5	6	7	Imp.Total	8	Total
Contents	Di H20	Di H20	Empty-		ļ				Silica Gel	Called Love Self
Final	94	103	101	-					313	· ·
Initial	100	100	נדטן						300	
Gain	- 6	3	1		-			-2	13	11.0
Impinger Cold	or <	Clear	53	nt DI Renz	Labeled?	har				
Silica Gel Cor		lear 1/4 c put	- 21	Dem Ring	Sealed?	- yes		- 2		•.
		<u></u>								
Run No.	3				Sample Date	12-Sep-00		Recove	ry Date	9/12/00
Sample I.D.	AF - I - LMF11	9 - 3 - M202 -	12SEP2000		Analyst	1.		Filter N	-	639
					Imping	er i				
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	Di H20	Di H20	Empty	, 					Silica Gel	
Final	ay	100	102						316	
Initial	100	100	100						300	
Gain	-6	-	192			/		-4	16	12.0
Impinger Color	r ci	LEAR	14		Labeled?	1.		L		
Silica Gel Con					Sealed?	NX				
		Medie Die die				/!}				
Check COC for 3	Sample IDS OF	wedia Blanks				1		$\overline{\mathcal{K}}$	150	EN.

Black J. Levett 642

Final Final O. (C. 2 Ves / no Ves / no Post-Test Set		- Ur
ECA Page 1 of K Factor 6/. 95// Initial Mid-Point 2.005 yes / no yes / no	Ves / Ind Max Vac Max Temp	
Labor Temp Part (1, 2) Check (1) Check (1) for Hg) good good for Hg) poly for Hg) good for Hg) for	Max Jemp	- I .
- Particulate - Particulate - 2 WL/1 -	PROBE TEMP (5) 2335 2336 2336 2336 2336 2336 2336 2336	
hod 5/202	Pow Nuent Pow 102 102 102 102 102 102 102 102 102 102	
EPA Meth Meter Box ID Meter Box ID Meter Box Y Meter Box Y Meter Box Del H Probe ID / Length Probe Material Pitot / Thermocoupl Pitot Coefficient Nozzle ID Area of Stack (ft ²) Sample Time Total Traverse PIs	The north the state	
EET Stack Conditions Assumed M M M M M S (F) M M 20.5 S S S S S S S S S S S S S S S S S S S	ORIFICE DRIFT 001110 01110 01110 01110 01110 01110 01110 01110 01110 01110 01110 01110 01110 01110 01110 01110 01110 0110 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101 01110 0101	0
D DATA SHEET M Stack 1.2000 % Moisture Inpinger Vol (ml) Silica gel (g) CO2, % by Vol CO2, % by Vol Temperature (°F) PW-100 Meter Temp (°F) 0 Static Press (in H ₂ O) Ambient Temp (°F)	Avg Sqri Della P Avg Sqri D Avg Sqri Della P Avg Sqri D Avg Sqri D A	<u> </u>
ISOKINETIC FIELD DATA SHEET Client USAF/EOM Stack A 0.# USAF/EOM Stack A 0.# 20054.006.001.2000 Project ID AF Moisture Mode/Source ID AF 04 01 Project ID AF 04 01 Tempinger Vol (m) 1 CO2. % by Vol Run No.ID 12SEP2000 Temperature (°F) Satic Press (in H ₂ O) Satic Press (in H ₂ O) Satic Press (in H ₂ O) Derator US 12.8000 Static Press (in H ₂ O) Satic Press (in H ₂ O) Satic Press (in H ₂ O) Satic Press (in H ₂ O) Static Press (in H ₂ O) St	2000× 1001 100	
ISOKINE Client W 0 # Project ID Mode/Source ID Samp Loc. ID Run No. ID Run No. ID Run No. ID Date ID Source/Location Sample Date Baro. Press (in Hg)		

	Final 0.005 Ves / no Post-Test Set	Pass / Fait yes / no COMMENTS				Je -
Page { of {	Mid-P Mid-P est Set	Pass / Fail yes / no LE yAC (g)				Max Temp
t C) t	K Factor Initial 0.00% Ves / no Pre-T	Pass yes SAMPLE TRAIN VAC (in Hg)		6000000		Max Vac 8.5
		2°) Response IMPING EXITTEMP EXITTEMP	11555555555555555555555555555555555555	665		Max Temp 64
FILL 657 late	Leak Checks Sample Train (ft ³) Leak Check @ (in Hg) Pitot good Orsat good Temp Check Meter Box Temp Reference Temp	Pass/Fail (+/- 2°) Temp Change Response FILTER IMPING BOX TEMP EXIT TEMP (F) (°F)	255 255 255	252		Min/Max C48/C56
Particulate	2 WC 19 1 7680 1 7680 800 0.84 0.84		222	251 251 252 254 254 254 251 251		Min/Max TLI US3
1			2000 2000 2000 2000	6 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		E SS
EPA Method 5/202	IH I couple ID a (in) (ft ²)	P PIS DGM INLET JEMP (*)	21350	24 100 100 100 100		Ave Tm C 3.1.C 5
EPA M	Meter Box ID Meter Box ID Meter Box Del H Meter Box Del H Probe ID / Length Probe Material Pitat / Thermocouple ID Pitat / Thermocouple ID Pitat Coefficient Nozzle ID Avg Nozzle Dia (in) Area of Stack (ft ²)	Tot Tot	83866	149 149 149 149 149		Avg Ts 145.33
	Actual	METE 5555	519.6 519.6 585.8 592.1 592.1	611, 43 612, 43 622, 155		Total Volume フ
,	Stack Conditions Assumed 3 3 0.5 1 1 1 20.5 1 1 20.5 1 1 20.5 1 1 20.5 1 1 20.5 1 1 20.5 1 1 20.5 1 2 1 2 1 2 1 2 1 2 2 2 2 2 2 2 2 2 2	CE HZO	1111		+++++++	
HEET	Stack Stack (m) (m) (vol e (°F) (i (m H ₂ O)	Imp (°F) ORIFICE 1 Delta H (In H20)	2.07 2.07 2.07 2.07 2.07	2000 2000 2000 2000 2000 2000 2000 200		
ISOKINETIC FIELD DATA SHEET	Stack % Moisture Impinger Vol (ml) Silica gel (g) CO2, % by Vol O2, % by Vol O2, % by Vol Temperature (°F) 100 Meter Temp (°F) Static Press (in H ₂ O)	Ambient Te VELOCITY VELOCITY PRESSURE Del P (In H20)	6000 8000 8000	2.08 2.09 2.09 2.09		Avg Sqrt Della P U. 29 699
FIELD 1	USAF/EGM 20054.006.001.2000 AF A LMF119 2 M202 12SEP2000 12-SEP-00 12-SEP-00	NMN NMN CLOCK TIME (plant time) 1712 1717	1211	25(1		
ETIC	Approx		2 2 2 2 2 3	232823		
ISOKIN	Client W. O.# Project ID Mode/Source ID Samp Loc. ID Run No. ID Run No. ID Test Method ID Date ID Source/Location Sample Date	Derator Operator FRAVERSE S POINT FONT				

	Final Final O.OCC yes / no yes / no yes / set Post-Test Set yes / no yes / no		
	K Factor (c), 9, 7// Initial Mid-Point US US US No yes / no Pre-Test Set Pre-Test Set yes / no yes / no yes / no yes / no		Max Temp
و	F. C. I. P. Pretor C. P. Pass / Pre-Tes	SAMPLE TRAIN VAC (in Hg) S.S.S.S.S.S.S.S.S.S.S.S.S.S.S.S.S.S.S.	MaxVac
tithe 630	(tr (ft ¹) (in Hg) mp mp s Response	XXXXXXE C C C C C C C C C C C C C C C C	Max Temp 7C
LŦ ·	late Leak Checks Sample Train (tt ³) Sample Train (tt ³) Leak Check @ (in Hg) Pilot good Orsat good Orsat good Temp Check Reference Temp Pass/Fail (+/- 2°) Temp Change Response	HILTER BOX TEMP (F) (F) (F) (F) (F) (F) (F) (F) (F) (F)	Min/Max 246/279
	- Particulate 2 WC 17 0 9895 Leak Boro Leak Pritot (0.84 Orsat 1 Temp	PROBE PROBE 2015 212 212 212 212 212 212 212 2	Mig/Max 243/256
	5/202 -]	0001ET 200 200 200 200 200 200 200 200 200 20	T T
		100 100 100 100 100 100 100 100 100 100	Avg Tm Avg Tm
	EPA Method Meter Box ID Meter Box Y Meter Box Y Meter Box Del H Probe ID / Length Probe Material Pitot / Thermocouple ID Pitot Coefficient Nozzle ID Avg Nozzle Dia (in) Area of Stack (ft ²) Sample Time Total Traverse Pts	2	21 Bry 21 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 -
	Actual	DRY GAS METER READING (1) 828, 855 828, 855 841, 9 841, 9 841, 9 874, 9 874, 9 874, 1 875, 1	Total Volume 7 8, 32 7 Comments:
	EET Stack Conditions Assumed (1) (1) (20, 5) (20, 5) (1) (1) (20, 5) (20, 5) (Odila H (in H20) Pella H (in H20) Pella H (in H20) S. I S. I C. I S. I C. I S. I C. I	Avg Delta H 5.000 23 Avg Sqn Del H 2., 23 5 5 5
-	ATA SHI Moisture Moisture Impinger Vol (r Silica gel (g) CO2. % by Vol Temperature (r Meter Temp (° Static Press (fr	Clock Twe VELOCITY Igain time PRESURE Dalls 18.19 P(m H20) 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 18.19 0.03 19.19 0.03 19.19 0.03	Avg Sqrt Delta P 0.29571
	IC FIELD DA USAFFEOM 20054.006.001.2000 AF A LMF119 3 M202 12SEP2000 12-SEP-00 2X.74 NM	1819 1900 1900 1900 1900 1900 1900 1900	c
		のとの下かいためなの	
	ISOKINE Client W O # Project ID * Project ID * Mode/Source ID Samp. Loc. ID Run No.ID Test Method ID Date ID Date ID Source/Location Sample Date Baro. Press (in Hg)	THAKERSE TOULT	

EPA Method 5/202 - Particulate

Client	-	USAF/	EQM	_	W.O. #		20054.00	06.001.2000		
Location/Pl	ant	Lockheed N	Martin GA	Sourc	e & Location			F119-PW-100		-
Run No. Sample I.D.	<u> </u>		- 125552000		Sample Date		•		-	9/12/00 63E
			- 12021 2000	-	Analyst	me	·	Filter	lumber	632
	1	2	3 64	2 4	Impinge 5	∍r 6	7	imp.Total	8	Tetal
Contents	Di H20	Di H20	Empty-	DIAZO						
Final	93++3	113	23-	113			·		318.7	
Initial	100	100	1000						300	
Gain	-7	13	13					19	18.7	37.7
Impinger Col	or 🧲	lear	<i>i</i>	Ediki	Labeled?	Yes				••••
Silica Gel Co	ndition	1/4 spect	<u> </u>	O Den Ru	Sealed?	Yes	-			-
Due N-										· · · · ·
Run No.	2				Sample Date			Recove	ery Date	<u>9/12/00</u>
Sample I.D.	AF - A - LMF	119 - 2 - M202	- 12SEP2000	•	Analyst	PAC		Filter N	lumber	637
	1	T			Impinge					
Contents	Di H20	2 Di H20	3 A. Empty	D. HW	5	6	7	Imp.Total	8	Total
Final	93	104	111						Silica Gel 321.4	
Initial	100	100	100	-						
Gain	-7	4	11	-	-		·	8	300 21.4	29.4
Impinger Cold		lan	50,	I di Rince	Labeled?			0		
			- 27.	nl Dem Re		Ter		·····		-
Silica Gel Cor		3/acpont			Sealed?	Jack				
Run No.	3				Sample Date	12-Sep-00		Recove	rv Date	1/12
Sample I.D.	AF - A - LMF	119 - 3 - M202 -	12SEP2000		Analyst	PAC			lumber	636
					Impinge	r				<u> </u>
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	Di H20	Di H20	- STATUS					TEREME		
Final	95	112	104	** 					320.1	
Initial	100	100	(00	<u> </u>					300	
Gain	-5	12	4]]	20./	31.1
Impinger Colo	r <u>C</u>	lear 4 escel			Labeled?	\checkmark		//		
Silica Gel Con	dition <u>3</u> /	'y ascel			Sealed?	\checkmark	·			

Check COC for Sample IDs of Media Blanks

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					yes / no yes i no	0u /	et Post-Test Set			Pass / Fall		COMMENTS											-											Max Temp	
wE Salu Pane		2	$\left \right $	10	Aresy no ye	yes / no ye	Pre-Test Set		Dana / Fail	Lass / Fail		L.		2	6.0	6.5	6.0	7.0	0.2	2'2	70	7.0	7,0	6.5						_				Max Vac Max	
-	-	- de c	Sample Train (ft ³)	Leak Check @ (in Hg)	q	R	heck	x Temp	e Temp \+/_ 2 ⁰ \	Tomo Chance Demondo		R IMPINGER	(°F)	5	29	5	60		19	1 62	67	63	63	9			 							< Max Temp 6 67	
ulate			Sample 7	Leak Che	Pitot good	Orsat good	Temp Check	Meter Box Temp	Reference 1emp			E FILTER	r) (F)	642 (-		_		244			2te	540	248	244			-						XEMMIN L	
- Particulate		28920	4	Boro		0.84	1~6	0.550	4 G	3 -		FROBE		240	-	246	251	252	252			922	252	ትሪሮ	- 224	 	 		-		_			XeM/niM 26 66	•
	NC										1		TEMP (°F)	60	-		94	44	94	16	56	96	95	76	96		_	_		-				9479 Tm V	
EPA Method 5/202	Ω	, - 190	cenath	erial C	Pitot / Thermocouple ID	cient	i i	UIA (IN)	ck (IT)	ree Pte	and an			90 20	76	93	94	44	94	94				. 96	96		 							94	
EPA	Meter Box ID	Meter Box Y		Probe Material	_ Pitot / Theri	Pitot Coefficient	Nozzle ID	Avg Nozzie Dia (in)		Total Traverse Pte		STACK		261	193	193	193	561.	193	194	h61	(93	[93	193	1 193		4							193 08	
	_	Actual							_	80	100 A	READING (ft ³)	111 106	9/4.1	920.9	927.8	934.8	941.9	948.9	955.8	962.8	769.7	976.4	983. L	990.080							/	/	Total Volume	Comments:
EET	0	Assumed			I	1	(j)	۲ و	1				Delta H (in H2O)	S.78	5.39	کي.وک	S.78	و. الا	5.78	ح وح	S.78	ج ، اوج	S.26	5,39	5.52							1			
ISOKINETIC FIELD DATA SHEET		000 % Moisture	Impinger Vol (ml)	Silica gel (g)	CO2, % by Vo	02, % by Vol	125cP2000 lemperature ("F)	Static Press (in H-O)		Ambient Temp (°F)		PRESSURE Delta	P (in H2O)	0.44	0.41	D.43	0.44	۰. ۲	0.4u	۰ برع	9.44	0.43	م . 0	17:0	9.42									Avg Sqrt Bélia P D, 655 Co 4	
FIELD	USAF/EQM	20054.006.001.2000 AF	z	LMF119	-	M202	125cP2000 Adiate E110.E	13-Sep-00	28.97	42		(plant time)		511	110	1125	1130	1135	1140	1145	11 50	12	1200	1205	1210									5	2
NETIC		3	e ID			 ⊇	•	•	în Hg)		SAMPI E	TIME (min)	0	5	õ	15	3	5	50	2	ç 2	Ę	30	5	ê										
ISOKI	Client	W. U. # Project 'D	Mode/Source ID	Samp. Loc. ID	Tool No.ID	Lest Method IU Date ID	Source/Location	Sample Date	Baro. Press (in Hg)	Operator	TRAVERCE	POINT																							

		15255 (WAD &	
WE \$ TOW Page 1 of K Factor 12.8182 Initial Mid-Point 0.009 yes / no yes / no yes / no Pre-Test Set Pass / Fail Yes / no	(in High IO II II IZ IZ IZ IZ IZ IZ IZ IZ		Max Vac Max Temp
difference (1990)	5 377 867 967 868		H Max Temp
Culate Leak Checks Sample Train (tt ³) Sample Train (tt ³) Leak Check @ (in Pitot good Orsat good Orsat good Temp Check Pass/Fail (+/- 2°) Temp Change Rei Pass/Fail (+/- 2°)			Xemodily 2
- P	14 12 12 12 12 12 12 12 12 12 12 12 12 12		Winning Manual Manua Manual Manual Manua
			404 Tm L
	197 197 197 197 197 197 197 197 197 197		\$0.16 \$0.76
Actual Actual Gas MeTer Actual			Total Volume 81769
ET tack Conditi Assum	Delta H (in H20) S. 37 S. 5 S. 5		Avg Delig H Avg Sqn Del H Con
ATA SHI Moisture Moisture Moisture Moisture Silica gel (g) CO2. % by Vol CO2. % by Vol Temperature (° Temperature (° Static Press (ir Ambient Temp VELOCITY RESSURE Delta	6 (m H20) 0.4200 0.4200 0.4		Avg Sqrt Defia P Dr. 65657 8 3
	1223 1223 1223 1223 12233 12223 12223 12233 12223 12233 123 12		
INE Tree ID			
ISOK Client W.O.# Project ID Mode/Sou Samp. Loc Run No.ID Test Meth Run No.ID Test Meth Date ID Date ID Source/Loc Source			

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EPA Method 5/202 - Particulate

Client	-	USAF	/EQM		W.O. #		20054.00	6.001.2000		
Location/P	lant .	Lockheed	Martin GA	Sour	ce & Location	n	Intermediate		100	-
	_			······						
Run No.					Sample Date	e 13-Sep-00	<u>)</u>	Recov	ery Date	9/13/0
Sample I.D.	<u> AF - N - LM</u>	F119 - 1 - M20	2 - 12SEP2000		Analyst	1			-	
			DEAL D	•	Imping			Filler	Number	_632
	1	2	3	4	5	6	7	Imp.Total	8	T
Contents	Di H20	Di H20	Empty			1	· · · · · ·		o Silica Gel	Total
Final	99	118	100]			321.9	Addition of the second second
Initial	100	100	100				-			+
Gain	-1	18	0				1	17	300	76.9
Impinger Co	lor	CLUM			Labeled?	Au				38.9
Silica Gel Co	ndition	3KY SPONT			Sealed?	111				-
					Sealed?					-
Run No.	2				Sample Date	/' \ 13-Sep-00		Recov	Doto	
Sample I.D.	AF - N - LMF	- 119 - 2 - M202	- 12SEP2000		Analyst	YhA	_		Number	7.13.00
,			DiHau	<u> </u>	Imping				Number	631
	1	2	3	4	5	6	7	Imp.Total	8	Tatal
Contents	Di H20	Di H20	-Empty-					19-20-Carrier	Silica Gel	Total
Final	94	114	108						324.2	1.
Initial	100	100	100						300	
Gain	-6	16	8		-			18	242	42.2-
Impinger Cold	or <u>c</u>	lean 4 me			Labeled?	\checkmark				
Silica Gel Cor	ndition <u>3/</u>	4 and			Sealed?	Ý				
Run No.	3			•	Sample Date	13-Sep-00		Recove	ry Date	
Sample I.D.	AF - N - LMF1	119 - 3 - M202 ·	12SEP2000		Analyst			Filter N	umber	630
					Impinge	er				
Contents	1	2	3	4	5	6	7	Imp.Total	8	Total
	Di H20	Di H20	Empty					1739 - 17 5	Silica Gel	TOTAL
Final										
Initial	100	100							300	
Gain									300	
Impinger Colo	r				Labeled?					J
Silica Gel Con	dition				-Sealed?					

Check COC for Sample IDs of Media Blanks

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or L Dirth Final Dirth Pass / Fail yes / no Pass / Fail yes / no Post-Test Set Pass / Fail yes / no Post-Test Set Dirth Pass / Fail Jail	J.
K Factor L G 2 7 K Factor L G 2 7 Initial Mid-Point 0.005 yes / no yes / no yes /	Max Vac Max Temp
Checks le Train (f ¹) food good good good good fin Hg) food fin Hg) food food fin Hg) food food food food food food food foo	Max Temp
- Particul Wein Probe Probe Probe Probe Probe Probe Probe Probe Probe Probe Probe Probe Probe Probe Prov	Xehnorin OSSCEL
100 2/20 100	Met Burk
	Total Volume Avg Ts 79.687 246.50
Assure of the second states of	Avg Delte H Total Vo 5.27553 79.66 Avg Sqrt Del H Comments:
FIELD DATA SHEET stack USAFIECM Stack USAFIECM Stack USAFIECM Stack Ist 006.001.2000 % Moisture AF % Moisture M mpinger vol (m) LMF119 Silica gel (g) 1 CO2, % by vol M202 O2, % by vol M202 O2, % by vol M202 Static Press (in H ₂ O) M202 Static Press (in H ₂ O) M203 Static Press (in H ₂ O) M204 Malent Temp (*) M202 Static Press (in H ₂ O) M203 Static Press (in H ₂ O) M204 Malent Temp (*) M204 Malent Temp (*) M204 M204 M205 M204 M204 M204 M205 M204 M204 M205 M204 M204 M204 M204 M205 M204 M204 M204 M205 M204 M204 M204 M205 M204<	Avg Sqrt Delta P
TIC 18 11 11 11 11 11 11 11 11 11 11 11 11	
ISOKINE Client W.O.# Project ID Mode/Source ID Samp. Loc. ID Run No.ID Test Method ID Date ID Date ID Source/Location Sample Date Baro. Press (in Hg) Operator	

	Pass / Fail yes / no Comments	for
A Page of actor L.4281 actor L.4281 Dia Ves./ no No Ves./ no / no Ves./ no Pre-Test Set	~!~!!	Max I emp
K Factor Initial Pre-T	NINT SO CO	Nax
(6H u	Temp Change Response Temp Change Response FILTER timPING BOX TEMP Change Response CF) (F) CF) (F) CF) (F) CF) (F) CHQ CQ CHQ CQ CHQ CA	
J]ate Leak Checks Sample Train (ft ³) Leak Check (in Pitot good Orsat good Meter Box Temp Reference Temp		A A A A A A A A A A A A A A A A A A A
2 - Particulate WC 19 WC 19 1,7680 1,7680 Leak 1,7680 1,7680 1,7680 1,7680 0.300 Meter Pitot G 0.300 Meter	новн темр (гр. 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,	0 Sternster
	на с 	C Lot
EPA Method 5/202 Meter Box ID Weter Box Y Weter Box Del H Probe ID / Length Probe ID / Thermocouple ID Avg Nozzle ID Probe ID / Length Probe ID / Length Pro	Star Star Star Star Star Star Star Star	a l
EPA Methoo Meter Box ID Meter Box Y Meter Box V Meter Box Del H Probe ID / Length Probe Material Pitot / Thermocouple ID Pitot Coefficient Nozzle Dia (in) Avg Nozzle Dia (in)		357.83
ed Actual	PRY GAS METER READING (R ⁺) 715. 808 7122. 4 7125. 0 7125. 0 7125. 0 7125. 0 7125. 0 7125. 1 715. 8 712. 4 7135. 8 7135. 8 715. 1 715. 1 71	Total Volume SO, SOY Comments:
EET Stack Conditions Assumed Assumed Assumed Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control Control C	0 ^(F) Preserve	Avg Deffa H Soft Del H Avg Sqrt Del H
ISOKINETIC FIELD DATA SHEET Client USAF/EQM Stack A/O.# JSAF/EQM Stack A/O.# 20054.006.001.2000 Mode/Source ID AF Moliture Mode/Source ID AF A SHEET Mode/Source ID USAF/EQM Stack Mode/Source ID AF A SHEET Mode/Source ID Date ID AF A SHEET (m) Stack A/O # Moliture A Mode/Source ID AF A SHEET (m) Stack A/O # Moliture A Mode/Source ID AF A SHEET (m) Stack A/O # Moliture A Mode/Source ID AF A SHEET (m) Stack A/O # Moliture A Mode/Source ID AF A SHEET (m) Stack A/O # Moliture A Mode/Source ID AF A SHEET (m) Stack A/O # Moliture A Mode/Source ID A SHEET (m) A Stack A/O # Moliture A Mode/Source ID A SHEET (m) A Stack A/O # Moliture A Mode/Source ID A SHEET (m) A Stack A/O # Moliture A Mode/Source ID A A SHEET (m) A Stack A/O # Moliture A Mode/Source ID A A SHEET (m) A Stack A/O # Moliture A Mode/Source ID A A A SHEET (m) A Stack A/O # Moliture A Mode/Source ID A A A A SHEET (m) A Stack A Moliture A A A Moliture A Mode/Source ID A A A A A A A A A A A A A A A A A A	Ambient Tem WELGOTY Risure Dage Risure Dage Plin H20 0.82 0.52 0.82 0.52 0.	0,89934
IC FIELD D USAF/EGM USAF/EGM 20054.006.001.2000 AF M LMF119 2 125EP2000 Military F119-PW-100 14 Jarsep-00	21-25 14-10 14-10 14-10 14-10 14-10 14-10 14-10 14-10 14-15	
ISOKINETIC Client W.O.# 22 Project ID Mode/Source ID Samp. Loc ID Run No.ID Test Method ID Test Method ID Test Method ID Source/Location		MERI

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EPA Method 5/202 - Particulate

Client		USAF/	EQM	_	W.O. #	20054.006.001.2000				
Location/Pl	ant	Lockheed I	Martin GA	Source	e & Location			=119-PW-100		-
Run No. Sample I.D.	<u>1</u> AF - M - LMF	- 119 - 1 - M202	2 - 12SEP2000)	Sample Date Analyst	13-Sep-00	•	Recove	9/14/0 634	
			DI #=0		Imping	07		r iiter r	Number	<u> </u>
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	Di H20	Di H20	Empty							
Final	108	110	102					320	320.5	
Initial	100	100	100					300	300	
Gain	8	10	2					20	20.5	
Impinger Col	or				Labeled?					
Silica Gel Co	ndition				Sealed?					
Run No.	2				Sample Date	13-Sep-00		Recove	ery Date	9/14/00
Sample I.D.	AF - M - LMF	119 - 2 - M202	- 12SEP2000	1	Analyst	PAC		Filter N	Number	633
	1	2	3 Di H	5 4	5	6	7	Imp.Total	8	Total
Contents		Di H20	Empty						Silica Gel	
Final	99	107	109		<u> </u>				323	
Initial	100	100	100						300	1 1
Gain	-, l	7	4	~				10	23	-
Impinger Cold	or \underline{C}	lear			Labeled?	400				
Silica Gel Cor	ndition	lear V2 sport			Sealed?	yes				
Run No.	<u>э</u>					0				``````````````````````````````````````
	3			;	Sample Date	13-Sep-00		Recove	ry Date	
Sample I.D.	AF - M - LMF1	19 - 3 - M202	- 12SEP2000		Analyst			Filter N	lumber	35
	1	2	3	4	Impinge 5	er 6		11		
Contents	Di H20	Di H20	Empty	*	3	0	7	Imp.Total	8 Silica Gel	Total
Final		-							Unite Gel	
Initial	100	100						1	300	
Gain								1		
Impinger Colo	mpinger Color				Labeled?			<u>1</u>	· · · · · · · · · · · · · · · · · · ·	<u> </u>
Silica Gel Con	dition				Sealed?					

Check COC for Sample IDs of Media Blanks



Final C.O.S S No Yes / no Post-Test Set Pass / Fail		Aft due to dight with a light the to the solid the to the solid the to t	- w
e L of ', 2,2,7/ Mid-Point View no yes / no Set		Delta Biski	Max Temp
	SAMPL TRAIN V (in Hig W W W W W W W W W W W W	mmnmmmmmmm	Max Temp Max Vac Max Ten 6 9 EPA Method 0011 from EPA SW-846
dehyde Leak Checks Sample Train (tt ³) Leak Check @ (in Hg) Filot good 1.0 Orsat good 1.0 Meter Box Temp Reference Temp Pass/Fail (+/. 2 ⁰) Temp Change Response	The state of the s	228865	Max Temp 6 9 EPA Method
Formaldehyde 8 016 016 1 16 16 16 17 10 </td <td></td> <td>529 529 529 529 529 529 529 529 529 529</td> <td>MindMax 24 b/251</td>		529 529 529 529 529 529 529 529 529 529	MindMax 24 b/251
- Forma 8 1.016 1.591 1.591 1.591 0.84 1.591 1.591 1.1016 1.591 1.1016 1.1	「いた」では、「「「「「「」」」	1000 24 Contraction	Min/Max 216/257
	Manual Contraction of the second seco	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
*EPA Method 001 Weter Box ID Weter Box Y Weter Box Y Weter Box Det H Probe ID / Length Probe ID / Length Probe Material Pilot / Thermocouple ID Pilot / Thermocoup	12 C C C C C C C C C C C C C C C C C C C	44 101 102 102 102 102 102 102 102 102 102	Aug ^{1m} 9,5,6
*EPA Metho Meter Box ID Meter Box Y Meter Box V Meter Box Det H Probe ID / Length Probe Material Pitot / Thermocouple ID Pitot / Thermocouple ID	STACK STACK	MULER MA TITITI	11 8.2 L
Actual		372.6 3.32.6 3.32.6 3.35.6 4.0 4.0 4.0 7.6 4.0 7.6 4.0 7.6 4.0 7.6 4.0 7.6 4.0 7.6 4.0 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6	Comments:
EET Stack Conditions Assumed Multiple 20.5 hH20 -0.02	ORIFICE OPINE I IN 120 Della I In 120 Della I In 120 D. 85222 C. 8546 C. 12846 C. 12846 D. 3846 C. 12846 D. 3846 C. 2846 D. 3846 D. 3866 D. 38667 D. 386670 D. 386670 D. 386670 D. 386670 D. 3866700 D. 3866700 D. 3866700 D. 3866700 D. 3866700000000000000000000000000000000000		0,5500367 Avg Delta H Avg Sert 850 Avg Sert Bel H Co, 93226
DATA SHEET stack book moisture Impinger Vol (m) Silica gel (g) co2. % by Vol 02. % by Vol 02. % by Vol 7emperature (°F) Meter Temp (°F) Static Press (in H ₂ O)			Avg Sqrt Delta P 0.1 vuv
FIELD USAFIEOM USAFIEOM 54.006.001.200 AF 1 1 1 1 M0011 12.SEP2000 5 F119-PW-10 12.SEP2000 5 24.06		12:09 12:19 12:39 12:39 12:39 12:39 12:39 12:39 12:39 1:29 1:29	
ISOKINE, FIC Client W.O.# 200 Project ID Mode/Source ID Samp. Loc. ID Run No.ID Test Method ID Date ID Source/Location Sample Date Baro. Press (in Hg)	TRAVERSE SAMPLE FONT TIME (mm) No FONT TIME (mm) No FONT TO FONT NO FONT TO FONT NO FONT TO FONT FONT	90 100 110 120 120 130 150 150 150 150	

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*EPA Method 0011 - Formaldehyde

Client	_	USAF/	EQM		W.O. #		20054.00	06.001.2000			
Location/PI	ant _	Lockheed I	Martin GA	Source	e & Location			19-PW-100	<u> </u>	-	
Run No.					Sample Date 12-Sep-00			Recovery Date			
Sample I.D.	AF - I - LMF1	19 - 1 - M0011	- 12SEP2000		Analyst	Ad	_	Filter N	Number		
		1			Imping	er					
Contents	1	2	3	4	5	6	7	Imp.Total	8	Total	
	DNPH	DNPH	DNPH						Silica Gel	Mens Mil	
Final	142	<u></u>	122						319.2		
Initial	100	100	100		-				300		
Gain	42	-50	22					194	19.Z	33.2	
Impinger Col	or <u>r</u>	DARK YELW	<u>.</u>		Labeled?	An	•				
Silica Gel Co	ndition <u>y</u>	2 SPENT			Sealed?		•			-	
	_										
Run No.	lo. <u>2</u>					12-Sep-00		Recove	ery Date		
Sample I.D.	AF - I - LMF1	19 - 2 - M0011	- 12SEP2000		Analyst			Filter Number			
					Imping	er		•			
Contents	1	2	3	4	5	6	7	Imp.Total		Total	
	DNPH	DNPH	DNPH	·····					Silica Gel		
Final										 	
Initial	100	100	100		<u> </u>				300		
Gain			-								
Impinger Cold	or				Labeled?						
Silica Gel Cor	ndition				Sealed?				<u> </u>	-	
·····										•	
Run No.				:	Sample Date	12-Sep-00		Recove	ry Date		
Sample I.D.	AF - I - LMF11	9 - 3 - M0011	- 12SEP2000		Analyst			Filter N	lumber		
		\$			Impinge	er -				1	
Cantanta	1	2	3	:4	5	6	7	Imp.Total	8	Total	
Contents	DNPH	DNPH	DNPH						Silica Gel	and the states of the	
Final											
Initial	100	100	100						300		
Gain											
Impinger Colo	mpinger Color				Labeled?						
Silica Gel Con	dition				Sealed?						

Check COC for Sample IDs of Media Blanks

WISSIGERI.

of / 2 36, 2 5 5 oint Final no yes / no post-Test Set	Pass / Fail · yes / no COMMENIS	RECEIVANT USE				M
K Factor 3, 5, 5, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	Pass / Fail yes / no samPLE TRAIN VAC (in Hg)	נבררב		1 2 2 2 2 2 5 5 5 2 2 2 2 2 5 5 5 5		Max Temp Max Vac Max Temp 61 8.9 EPA Method 0011 from EPA SW-846
dehyde Leak Checks Sample Train (ft ³) Leak Check @ (in Hg) Pitot good Orist good Temp Check Meter Box Temp	e Response e Response (MPINGER EXIT TEMP (°F)	55 55 25 55 25 55 25 555 25 555	10000000000000000000000000000000000000	n Jean ena	C	
	PROBE EMP (°F)		onedmi	22222222222222222222222222222222222222	मट २	Min/Max Min/Max 220/255 247-1251
- 100 bd	LET 0UTLET T	<u>0</u> 9992	011 04 201 201 201 201	108 108 108 108 108 108 108 108 108 108	102	ача та 8 0 - 11 1 9
* EPA Method 0011 Meter Box ID Meter Box Y Meter Box Y Meter Box Det H Probe ID / Length Probe ID / Length Probe Material Pitot / Thermocouple ID Pitot Coefficient Nozzle ID Moo Orzale Dia (in)	Sample Time Total Traverse Pts STACK DGM IN TEMP (°F) TEMP (Arg Ter
Actual	RY GAS METER READING (R ¹)	20-00	R MA	n de se se un	23.314 14	Total Volutie A 196.573 1. Comments:
EET Stack Conditions Assumed m) Assumed Assumed above Control of the control of t	(°F) qO ORIFICE PRESSURE Delta H (in H2O)	2002		2.20 2.20 2.20 2.20 2.20 2.20 2.20 2.20	06.6	Avg Delight 3, 1811 Avg sen Del H Co 1, 78242
FIELD DATA SHEET USAF/EOM Stack USAF/EOM Stack 54.005.001.2000 % Moisture AF % Moisture Impinger Vol (mi) % by Vol LMF119 Silica gel (g) 1 Co2. % by Vol M0011 Co2. % by Vol 12SEP2000 Temperature (°F) 12-SEP-00 Static Press (in H-O)	Ambient Temp (°F) Ambient Temp (°F) VELOCITY PRESSURE Delta PI P (in H2O) Delt	0.09 0.08 0.08	0.08 0.09 0.09 0.09	0.08	20.08	Avg Sqr Delta P Ö. 2960 8
		10.10 10 10 10 10 10 10 10 10 10 10 10 10 1	101-101 101-101	10 20 49 49 49 49 49 49 49 49 49 49 49 49 49		
ISOKINE TIC Client W.O.# 200 Project ID Mode/Source ID Samp. Loc. ID Run No.ID Test Method ID Date ID Source/Location Source/Location	Baro Press (in Hg) Operator TRAVERSE SAMPLE TRAVERSE SAMPLE	5 3 G	29888 29888	011 021 021 021		MERICAN

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*EPA Method 0011 - Formaldehyde

Client		USAF/	EQM		W.O. #		20054.0			
Location/Pla	ant	Lockheed I	Martin GA	Sourc	e & Location		Approach	F119-PW-10	0	-
Run No. Sample I.D.	 AF - A - LMF	A-LMF119-1-M0011-12SEP2000 0 ~1 50M 75W]	Sample Date <u>12-Ser</u> Analyst Em a		0 Recovery Date Filter Number			12Septo
RINDE	YO MI				Impinge					
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	DNPH	DNPH	DNPH			·			Silica Gel	
Final	107	118	92						336.0	
Initial	100	100	100		-				300	
Gain	7	18	-8					17	36.6	53.6
Impinger Colo	or – j	eller-			Labeled?		-	•		
Silica Gel Co	ndition	12 blue			Sealed?					_
Run No. 2 Sample Date 12-Sep-00 Recovery Date										
Sample I.D.	AF - A - LMF	119 - 2 - M001	1 - 12SEP2000		Analyst Filter Number					
		· · · · · · · · ·	1		Impinge)r				
Contents	1 DNPH	2	3	4	5	6	7	Imp.Total	8	Total
Final	Jes	DNPH	DNPH						Silica Gel	itan 1992
Initial	100	100	100]
Gain	100		100						300	
Impinger Cold)r		<u>1</u>		Labeled?					L]
Silica Gel Cor	dition				Sealed?		· · · · · · · · · · · · · · · · · · ·			
	3				Sample Date	12-Sep-00		Recove	ry Date	
Sample I.D.	AF - A - LMF1	19 - 3 - M0011	- 12SEP2000		Analyst			Filter N	lumber	
	4	0			Impinge	-				
Contents	1 DNPH	2 DNPH	3 DNPH	4	5	6	7	Imp.Total	8	Total
Final			014-11		+		·····		Silica Gel	denta -
		4.6								
Initial	100	100	100					┨	300	
Gain	l		I				****			
Impinger Color					Labeled?					
Silica Gel Con	dition			,,	Sealed?	- 1				

Check COC for Sample IDs of Media Blanks

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or / int Final 0.004 Post-Test Set Post-Test Set		Stopen 6 13:1; Veleme = 753 3 5 topen 6 luck at 123,1	Mar
K Factor 2, 479 Initial Mid-Pc 0.012 ves / r ves / no ves / r Pre-Test Set			Max Temp Max Vac Max Temp 66 C
 Formaldehyde 8 1.016 1.016 1.016 1.591 Leak Checks 1.591 Leak Check (in Hg) Boro Leak Check (in Hg) Boro Leak Check (in Hg) Pitot good 0.84 Orsat good 0.84 Orsat good 1.50 Pass/Fail (+/. 2⁰) 1 Temp Change Response 		2 2 A C	MINNAX 1416
	0011EH 00303033330 00203033330 00203033330 00203033330 00203033330 00203033330 00203033330 0020303330 0020303330 002030330 00200000000		C. T. C. MinMax C. T. C.
*EPA Method 0011 Meter Box ID Meter Box ID Meter Box V Meter Box Vel H Probe ID / Length Probe Material Pitot / Thermocouple ID Pitot Coefficient Pitot Coefficient Nozzle ID Area of Stack (ft ²) Sample Time Total Traverse Pts	1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	8, 1 8, 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	201 (1) (0)
EET Stack Conditions Assumed Actual Assumed Actual Actual Assumed Actual	10E DRY GAS METER SURE READING (11) (11120) (11120) (1120)		1 Dei H Comments:
FIELD DATA SHEET USAF/EQM stack C USAF/EOM stack C USAF/EOM stack C Stack C stack C Stack C stack C AF mpinger Vol (m) LMF119 stilica gel (g) LMF119 stilica gel (g) LMF119 stilica gel (g) LM0011 O2. % by Vol M0011 O2. % by Vol Model F119-PW-100 Meter Temp (°F) Mattic F119-PW-100 Static Press (in H_2O) Static Press (in H_2O) Static Press (in H_2O)	VELOCITY ORIFICE PRESSURE Delta PRESSURE P (in H20) Delta P (in H20) Divid P (in H20) Divid <t< td=""><td></td><td>Avg Squt Delta P Avg Delta H Avg Sqn Del H Avg Sqn Del H</td></t<>		Avg Squt Delta P Avg Delta H Avg Sqn Del H Avg Sqn Del H
	PLE CLOCK TIME (mm) (paanting) (mm) (paanting)		
ISOKINL, fIC Client W.O.# 200 Project ID Mode/Source ID Samp. Loc. ID Run No.ID Test Method ID Test Method ID Date ID Source/Location Date ID Source/Location Baro. Press (in Hg)		951 92 92 92 92 92 92 92 92 92 92 92 92 92	

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*EPA Method 0011 - Formaldehyde

Client	-	USAF	/EQM	_	W.O. #	20054.006.001.2000				
Location/Pla	ant	Lockheed	Martin GA	Sourc	e & Location		ntermediate	F119-PW-1	00	-
Run No.	_1				Sample Date		<u> </u>	Recov	ery Date	13 Septi
Sample I.D.		F119 - 1 - M001		0	Analyst	<u> 2m3</u>	-	Filter I	Number	
Runic	90	1140	150	4	Imping				·	
Contents	DNPH	DNPH	DNPH	4	5	6	7	Imp.Total	8 Silica Gel	Total
Final	146	110	102						325.6	1920-09.14
Initial	100	100	100		-				300	· ·
Gain	14	10	2					28	25,6	531
Impinger Color <u>1/2 blue</u> Labeled?								<u>_</u>		
Silica Gel Co	ndition	yellow	<u></u>		Sealed?					_
Run No. 2 Sample Date 12-Sep-00 Recovery Date										
Sample I.D.	AF - N - LMF	119 - 2 - M001	1 - 12SEP2000)	Analyst		_	Filter N	lumber	
	Impinger									
Contents	1 DNPH	2 DNPH	3 DNPH	4	5	6	7	Imp.Total	8	Total
	DIT	Diarit	DINFIT				<u> </u>		Silica Gel	and the second
Final		<u> </u>	<u> </u>			·				۱ ۱
Initial	100	100	100				 		300	
Gain		<u> </u>	<u> </u>	<u> </u>			-			
Impinger Colo	r				Labeled?					
Silica Gel Con	dition				Sealed?			-		_
Run No.	3				Sample Date	12-Sep.00		Passus		
Sample I.D.		19 - 3 - M0011	- 12SEP2000		Analyst	12-060-00		Recove Filter N	•	
Ī			······		Impinge	r	•			
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	DNPH	DNPH	DNPH						Silica Gel	
Final										
Initial	100	100	100	w					300	
Gain										
Impinger Color	npinger Color									J
Silica Gel Cono	tition				Sealed?					

Check COC for Sample IDs of Media Blanks

Final VATes / no yes / no Post-Test Set Pass / Fail yes / no	RINIA 212-2-2412-2 212-2 212-2 2	5100 400 × 314 1 5100 400 × 1 = 555 24 5100 100 × 1 = 555 24 5100 × 1 = 55	
L of L 55/8 1 no	5100	5100 VOL. 5100 CLOK 5100 CLOK 5100 CLOK 5100 CLOK 5100 CLOK 5100 CLOK 5100 CLOK 5100 CLOK 5100 CLOK	Max Temp SW-848
K Factor Z, g. Initial Mid 0.000 Ves / no ves ves / no ves Pre-Test Set Pre-Test Set	sample Italin vac (in Hg) イントレート		May Temp Max Vac Max Ter L) L) EPA Method 0011 from EPA SW-946
ده الم الم الم الم الم الم الم الم الم الم		22462	Max Temp N EPA Method 001
- Formaldchydc 8 1.016 1.51 1.51 Leak Checks 1.51 Boro Leak Checks 0.84 D.84 O.84 Orsat good 1 180 Pass/Fall (H-2 ⁰) 1 1 1 1		20-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-	24 York
	TEMP Caller TEMP		XEMINIM
thod 001			The state of the s
*EPA Method 0011 Meter Box ID Meter Box Y Meter Box Det H Probe ID / Length Probe Material Priot Coefficient Piot Coefficient Nozzle ID Avg Nozzle Dia (in) Area of Stack (ft ²) Sample Time Total Traverse Pts		A STANDARD	1 /2 - 64 4
	Real Property and the second s	a sta sa	June 2
ET Stack Conditions Assumed Assumed P P P P P P P C C T C C C C C C	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	200 23.06 23.06 23.00 23.00 23.00 23.00 23.00 23.00 23.00 23.00 23.00 23.00 24.00 25	
TA SHEET Stack & Moisture Impinger Vol (ml) Silica gel (g) CO2, % by Vol O2, % by Vol O2, % by Vol O2, % by Vol CO2, % by Vol Static Press (in H ₂ O) Static Press (in H ₂ O)			Avg Delta H Avg Sqrt Del H Avg Sqrt Del H
Y		200 200 280 280 280 280 280 280 280 280	a cind the give
IC FIELD I USAFIEQM USAFIEQM 20054.006.001.2000 AF M I I I M M I I I M M I I I SEP2000 Military F119-PW-10 I I SEP2000 38,94 M			
ISOKINETIC Client W.O.# Project ID Project ID Mode/Source ID Samp. Loc. ID Run No.ID Test Method ID Date ID Date ID Source/Location Source/Location Baro. Press (in Hg) Operator		00 00 00 00 00 00 00 00 00 00 00 00 00	

*EPA Method 0011 - Formaldehyde

Client	_	USAF/	EQM		W.O. #		20054.00					
Location/Pla	ant _	Lockheed N	Aartin GA	Source	& Location			119-PW-100	·····	-		
Run No. Sample I.D.	<u>1</u>		1 12650200	0	Sample Date <u>13-Sep-00</u> Analyst			Recovery Date 9-14-00				
Cample I.D.		119-1-WUU1	1- 123EP200	0	Analyst			Filter I	Number			
	1	2	3	4	Imping 5	er6	7	Imp.Total	np.Total 8 Total			
Contents	DNPH	DNPH	DNPH			<u> </u>			Silica Gel			
Final	122	1:10	18					r dowdy.	9m5.227 285	4		
Initial	100	100	100		-				300	1		
Gain	22	16	-2	•				36	27.4	63.4		
Impinger Col	о г				Labeled?				•••••••••••••••••••••••••••••••••••••••			
Silica Gel Co	ndition				Sealed?					-		
Run No.					Sample Date	12-Sep-00	•	Recove	ery Date			
Sample I.D.	AF - M - LMF	119 - 2 - M001	1 - 12SEP200	0	Analyst Filter Number							
		T			Imping	1						
Contents	1 DNPH	2 DNPH	3 DNPH	4	5	6	7	Imp.Total	8	Total		
			<u>ON T</u>					100 (30 - 6 6 84)	Silica Gel			
Final					· · ·							
Initial	100	100	100						300			
Gain		l	-									
Impinger Colo	or				Labeled?							
Silica Gel Cor	ndition				Sealed?			-	,			
Run No.	3				Sample Date	12-Sep-00		Recove	ery Date			
Sample I.D.	 AF - M - LMF1	119 - 3 - M0011	- 12SEP2000		Analyst		•		lumber			
-					Impinge	er	<u> </u>					
	1	2	3	4	5	6	7	Imp.Total	8	Total		
Contents	DNPH	DNPH	DNPH	w				The second s	Silica Gel			
Final				- 14								
Initial	100	100	100						300			
Gain												
Impinger Colo	Impinger Color						Labeled?					
Silica Gel Con	dition	2: 4			Sealed?							

Check COC for Sample IDs of Media Blanks



APPENDIX B

PARTICULATE ANALYTICAL RESULTS

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ANALYTICAL DATA QUALITY PACKAGE

PREPARED BY PHILIP ANALYTICAL

PROJECT 196995

FOR Roy F. Weston, Inc.

SAMPLED: September 12, 2000

CLIENT CONTACT: Pete Virag

00001

4418 Pottsville Pike, Reading, PA 19605 (610) 921-8833 (610) 921-9667 fax

Philip Analytical Services Data Deliverables Package TABLE OF CONTENTS

SECTION

PAGE NUMBER

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Title Page/Sample Key	4
Chain of Custody	6
Internal Chain of Custody Records	12
Methodology Summary	14
Laboratory Chronicle	20
Case Narrative/Non-Conformance Summary Report	25
Analytical Sample Results for All Parameters/Final Report	27

2-3

Title Page/Sample Key

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	Lab
Field ID	Sample ID
AF-A-LMF119-1-M202-12SEP2000-FHA, FILT #638, BHC, BHS	1420084
AF-A-LMF119-2-M202-12SEP2000-FHA, FILT #637, BHC, BHS	1420085
AF-A-LMF119-3-M202-12SEP2000-FHA, FILT #636, BHC, BHS	1420086
COMP: AF-A-LMF119-1-3-M202-12SEP2000-FILT #636, 637, 638	1420087
AF-I-LMF119-1-M202-12SEP2000-FHA, FILT #641, BHC, BHS	1420088
AF-I-LMF119-2-M202-12SEP2000-FHA, FILT #640, BHC, BHS	1420089
AF-I-LMF119-3-M202-12SEP2000-FHA, FILT #639, BHC, BHS	1420090
AF-I-LMF119-SB-M202-12SEP2000-ACE, FILT #642, DCM, DIH2O	1420091
COMP: AF-I-LMF119-1-3-M202-12SEP2000-FILT #639, 640, 641	1420092
AF-M-LMF119-1-M202-12SEP2000-FHA, FILT #634, BHC, BHS	1420093
AF-M-LMF119-2-M202-12SEP2000-FHA, FILT #633, BHC, BHS	1420094
AF-M-LMF119-3-M202-12SEP2000-FILT #635	1420095
COMP: AF-M-LMF119-1-3-M202-12SEP2000-FILT #633, 634, 635	1420096
AF-N-LMF119-1-M202-12SEP2000-FHA, FILT #632, BHC, BHS	1420097
AF-N-LMF119-2-M202-12SEP2000-FHA, FILT #631, BHC, BHS	1420098
AF-N-LMF119-3-M202-12SEP2000-FILT #630	1420099
COMP: AF-N-LMF119-1-3-M202-12SEP2000-FILT #630, 631, 632	1420100
Filter W646	1421165
Filter W647	1421166
Filter W648	1421167

Page 1 of 1

Chain-of-Custody

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Chain-of-Custody Record/Lab Work Request

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	Client	· · · · · · · · · · · · · · · · · · ·		I, Lockheed I					_ot_ <u>4</u>]
	Work Order N			5.001.2000	Phone Nu		610-70		
	Contact Perso	n	Pete	Virag	Turn Arou		Stan		ļ
				<u></u>	Analy	/ses Requ	ested/Other	Info	
Lab ID		Field Sample ID		Sample Collection Date	Analysis	Filter #			Sample Check-off
	AF - A - LMF11	9 - 1 - M202 - 12SEP2000 - FHA		9/12/00	M202	1			
	AF - A - LMF11	9 - 1 - M202 - 12SEP2000 - FILT		9/12/00	M202	638			
	AF - A - LMF11	9 - 1 - M202 - 12SEP2000 - BHC		9/12/00	M202				
	AF - A - LMF11	9 - 1 - M202 - 12SEP2000 - BHS		9/12/00	M202				
	AF - A - LMF11	9 - 2 - M202 - 12SEP2000 - FHA		9/12/00	M202			•	
	AF - A - LMF11	9 - 2 - M202 - 12SEP2000 - FILT		9/12/00	M202	637-			
	AF - A - LMF11	9 - 2 - M202 - 12SEP2000 - BHC	,	9/12/00	M202				1
	AF - A - LMF11	9 - 2 - M202 - 12SEP2000 - BHS		9/12/00	M202				
	AF - A - LMF11	9 - 3 - M202 - 12SEP2000 - FHA		9/12/00	. M202				
	AF - A - LMF11	9 - 3 - M202 - 12SEP2000 - FILT		9/12/00	M202	636			
	AF - A - LMF11	9 - 3 - M202 - 12SEP2000 - BHC		9/12/00	M202				1
	AF - A - LMF11	9 - 3 - M202 - 12SEP2000 - BHS		9/12/00	M202				
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lotes:	M5 - Gravimetric	Analysis per EPA Method 5 for fr	ont half and Ef	PA Method 20	2 for Back I	Half			
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		& ENSWIDVAR follower	to a five	my Runs 1	1-3 Air	Ters 7	zun n		
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- Change	uisned by	Received By	Date	Time			b Use Only		
KAU	m	stalling	19 5000	100	Shipper	PAS	Air Bill #		
	•	That	9-19-00	1435	Opened By	ang	Date/Time		
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iboratory Co	mments:	I			Custody Se	ais. Tes	No None		· · · · · · · · · · · · · · · · · · ·
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Chain-of-Custody Record/Lab Work Request

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	Client						Page 2	_ot_7
	Work Order Number		Lockheed 1	Phone Nui		610-70		╡.
	Contact Person	Pete		Turn Arou		Stan		4
						ested/Othe		L L
Lab ID	Field Sample ID		Sample Collection Date	Analysis	Filter #			Sample
	AF - I - LMF119 - 1 - M202 - 12SEP2000 - FHA				<u> </u>			Check-off
	AF - I - LMF119 - 1 - M202 - 12SEP2000 - FILT		9/12/00 9/12/00	M202 M202	64.1			+
	AF - I - LMF119 - 1 - M202 - 12SEP2000 - BHC		9/12/00	M202	641			
<u></u>	AF - I - LMF119 - 1 - M202 - 12SEP2000 - BHS		9/12/00	M202	<u> </u>		······	+
	AF - I - LMF119 - 2 - M202 - 12SEP2000 - FHA		9/12/00	M202			······································	+
	AF - I - LMF119 - 2 - M202 - 12SEP2000 - FILT		9/12/00	M202	640			
· · · · · · · · · · · · · · · · · · ·	AF - I - LMF119 - 2 - M202 - 12SEP2000 - BHC		9/12/00	M202	010		·······	
	AF - I - LMF119 - 2 - M202 - 12SEP2000 - BHS		9/12/00	M202				+
······	AF - I - LMF119 - 3 - M202 - 12SEP2000 - FHA		9/12/00	M202				
	AF - I - LMF119 - 3 - M202 - 12SEP2000 - FILT		9/12/00	M202	639		<u> </u>	
	AF - I - LMF119 - 3 - M202 - 12SEP2000 - BHC		9/12/00	M202			····	
	AF - I - LMF119 - 3 - M202 - 12SEP2000 - BHS		9/12/00	M202 M202				+
	AF - I - LMF119 - SB - M202 - 12SEP2000 - ACE		9/12/00	M202				
	AF - I - LMF119 - SB - M202 - 12SEP2000 - FILT		9/12/00	M202	642			
	AF - I - LMF119 - SB - M202 - 12SEP2000 - DCM		9/12/00	M202	010			+
	AF - I - LMF119 - SB - M202 - 12SEP2000 - DIH20	D	9/12/00	M202				
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1-4								
Notes:	M5 - Gravimetric Analysis per EPA Method 5 for fro	ont half and EP	PA Method 20	02 for Back H	Half			
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aboratory Cor	nments:		· · · .					
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Chain-of-Custody Record/Lab Work Request

	Client			 Lockheed 				
	Work Order I		20054.00	5.001.2000	Phone Nu		610-701-732	27
	Contact Pers	on	Pete	Virag	Turn Arou	Ind Time	Standard	
					Analy	/ses Requ	ested/Other Info	
				Sample Collection	Analysis	Filter #		Samp
Lab ID		Field Sample ID		Date		<u> </u>		Check
		19 - 1 - M202 - 12SEP2000 - FHA		9/13/00	M202			
		19 - 1 - M202 - 12SEP2000 - FILT		9/13/00	M202	634		
		19 - 1 - M202 - 12SEP2000 - BHC		9/13/00	M202			
		19 - 1 - M202 - 12SEP2000 - BHS	and the second s	9/13/00	M202	ļ		
		<u>19 - 2 - M202 - 12SEP2000 - FHA</u>		9/13/00	M202			
		19 - 2 - M202 - 12SEP2000 - FILT		9/13/00	M202	633		
		19 - 2 - M202 - 12SEP2000 - BHC		9/13/00	M202			
		19 - 2 - M202 - 12SEP2000 - BHS		9/13/00	M202			
	AF-M-LMF1	19 - 3 - M202 - 126EP2000 - FHA		9/13/00	M202			
		19 - 3 - M202 - 12SEP2000 - FILT		9/13/00	. M202	635		
	AF-M-LMF1	19-3-M202-12SEP2000-BHC	-	9/13/00	M202			
	AF-M-LME1	19 - 3 - M202 - 12SEP2000 - BHS	<u>مسري</u>	9/13/00	M202			
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atory Con	ndents.							مسك

Chain-of-Custody Record/Lab Work Request

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	Client Work Order Number		A, Lockheed N					
	Work Order Number Contact Person		5.001.2000 Virag	Phone Nur Turn Arou		610-70	4	
			Vilag				ndard	4
Lab ID	Field Sample ID		Sample Collection	Analysis	Filter #	ested/Othe		Sample
	AF - N - LMF119 - 1 - M202 - 12SEP2000		Date		<u> </u>			Check-o
	AF - N - LMF119 - 1 - M202 - 123EF2000		9/13/00 9/13/00	M202	632			
	AF - N - LMF119 - 1 - M202 - 12SEP2000		9/13/00	M202 M202	676	+		
	AF - N - LMF119 - 1 - M202 - 125EP2000	the second s	9/13/00	M202			<u> </u>	
	AF - N - LMF119 - 2 - M202 - 12SEP2000		9/13/00	M202		1		_
·····	AF - N - LMF119 - 2 - M202 - 12SEP2000	and the second sec	9/13/00	M202	631		<u> </u>	
	AF - N - LMF119 - 2 - M202 - 12SEP2000		9/13/00	M202	031		 	
	AF - N - LMF119 - 2 - M202 - 12SEP2000		9/13/00	M202				
. <u></u>	AF-N-LMF119-3-M202-123EP2000-		9/13/00	M202				
	AF - N - LMF119 - 3 - M202 - 12SEP2000		9/13/00	M202	630			
	AF - N_LMF119 - 3 - M202 - 12SEP2000		9/13/00	- M202 U	030	+		
	AF-N-LMF119-3-M202-125EP2000	and the second se	-9/13/00	- M202 U		+		
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	M5 - Gravimetric Analysis per EPA Method	5 for front hair and El	PA Method 20	12 for Back I	falt			,
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my c	- many steps		100	Shipper P	D_	Air Bill #		
	man	9/19/00	1435	Opened By	har	Date/Time)	
				Temp °C	2			+
					~0	Condition		<u>~</u>
					als: Yes	No Nor		

																			WESTON Analytics Use Only	COC Tape was:	1) Present on Outer	aunaya i ol		3) Present on Sarr		0				381-596a
ب						INORG	Metal	ics Use Only +											WESTON Ana	Samples were:	1) Shipped or	- Airbill #	2) Ambient or Chilled	3) Received in Good	- Condition Q or N	- 4) Labels Indicate	N IN Y OF N	5) Received Within Holding Times	5	Cooler#
Custody Transfer Record/Lab Work Request								WESTON Analytics Use Only																			Discrepancies Between	Samples Labels and COC Record? Y or NOTES.	<u></u>	L378 Ref#
/Lab Wor						ORGANIC	AOA Pest PCB PCB																				Date Time D	28/00/11/00/22		F377 L
Record		talner Solid	Liquid	Solid	68		4		Date Time Collected Collected										SNS:								ved	(ab)		L375
ansfer	Refrigerator #	#/Type Container	- milex		Preservatives				Matrix										DATE/REVISIONS:	- - 		ຕ ຕ	4	чс 	5	0.		X		L373
dy Tre			200						Matrix QC (V) MSD											2	Ì						Relinquished	5 07		L372 [.]
[]]]]	EQM	Ing Date and and	٠ 🛉	1 - Hell Mills		el TAT	Da		Client ID/Description	FLIDE WIGHG		3							FIELD PERSONNEL: COMPLETE ONLY SHADED AREAS	- / nor and	box when an an an firster		ATTENTEN UPERNO UNCULI	0			Received Date Time	1 Kater 6/200 1405		
196795	Client USAF	Est. Final Proj. Sampling Date	Work Order #	Project Contact/Phone #	AD Project Manager	OC Del	e Rec'd	N A TOIX	Sediment Sediment Solicitation	SL- Siluage W- Water	A - <u>6</u> -	DS - Drum Solids	DL - Drum Liquids	L- EP/TCLP Leachate	W1 - Wipe X - Other	F. Fish			FIELD PERSONNEL: C	special Instructions:	MBM Kod		ATTENTEN				Relinquished R	Jack Mills 17		RFW 21-21-001/A-7/91

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Internal Chain-of-Custody Records

PHILIP ANALYTICAL SERVICES INTERNAL CHAIN OF CUSTODY USE MILITARY TIME

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DATE OF SAMPLE TRANSFER	TO STORAGE:	(ney apoloo	TIME: 1200	вү: (Xa)
LAB SAMPLE ID	DATE/TIME REMOVED	ANALYSIS PERFORMED	DATE/TIME RETURNED	BY	USED ALL?
1420084 - 100	0900HXS 9/20/00	Mettre 202 Mettre 5		JH, TD	(VIN
1241165-67		Mettre 5		10	Y/N
					Y/N
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					Y / N
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					Y/N

COMMENTS:

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196995 Roy F. Weston, Inc.

1420084-1420100

DUE: 26-SEP-00

# Methodology Summary

### **METHODOLOGY SUMMARY**

### Philip Analytical Services Reading, Pennsylvania

### **ENVIRONMENTAL ORGANICS:**

### AQUEOUS, WASTEWATER METHODOLOGY, (REF 1, 3)

METHOD PERF

PERFORMED

PURGEABLE ORGANICS BY GC/MS	624	()
BASE-NEUTRAL/ACIDS BY GC/MS	625	()
ORGANOCHLORINE PESTICIDES/PCBS BY GC	608	()
PURGEABLE ORGANICS BY GC	601/602	
MISC	·	()

### SOIL & SEDIMENT, GROUNDWATER METHODOLOGY, (REF 2)

PURGEABLE ORGANICS BY GC/MS	8240/8260	()
BASE-NEUTRAL/ACIDS BY GC/MS	8270	()
PURGEABLE ORGANICS BY GC	8010/8020	()
ORGANOCHLORINE PESTICIDES/PCBS BY GC	8080/8081/8082	()
HERBICIDES	8151	()
EXPLOSIVES	8330/8332	()
DRO/GRO/GLYCOLS BY GC	8015, Modified	()
MISC		()

### **ENVIRONMENTAL METALS:**

#### SAMPLE PREPARATION, AQUEOUS, (REF 1)

#### METHOD PERFORMED

ICAP PREP & ANALYSIS	200.7	( )
FLAME ATOMIC ABSORPTION	200.0	()
FURNACE ATOMIC ABSORPTION	200.0	( )
MERCURY SAMPLE PREP & ANALYSIS	245.1	( )

### SAMPLE PREPARATION, SOIL & SEDIMENT, GROUNDWATER, (REF 2)

ICAP SAMPLE PREP & ANALYSIS	6010	()
FLAME ATOMIC ABSORPTION	3050	( )
FURNACE ATOMIC ABSORPTION	.3050	( )
MERCURY SAMPLE PREP & ANALYSIS	7471	( )

### FLAME AA (AQUEOUS/NON-AQUEOUS), (REF 1, 2)

ALUMINUM	202.1/7020	
ANITMONY	204.1/7040	()
BARIUM	208.1/7080	()
BERYLLIUM	210.1/7090	()
CADMIUM	213.1/7130	()
CALCIUM	215.1/7140	( )
CHROMIUM	218.1/7190	()
COBALT	219.1/7200	()
COPPER	220.1/7210	( )
IRON	236.1/7381	( )
LEAD	239.1/7420	( )
MAGNESIUM	242.1/7450	( )
MANGANESE	243.1/7460	()
MOLYBDENUM	246.1/7480	()
NICKEL	249.1/7520	()
POTASSIUM	258.1/7610	( )
SILVER	272.1/7760	( )
SODIUM	273.1/7760	()
TIN	284.1/7870	()
TITANIUM	283.1	()
VANADIUM	283.1/7910	( )
ZINC	289.1/7950	( )

### FURNACE AA (AQUEOUS/NON-AQUEOUS), (REF 1, 2)

ANTIMONY	200.9/7041	( )
ARSENIC	200.9/7060	( )
BERYLLIUM	200.9	( )
CHROMIUM	200.9/7060	( )
LEAD	200.9/7421	( )
THALLIUM	200.9/7841	( )
NICKEL	200.9/7520	( )
SELENIUM	200.9/7741	( )

### ENVIRONMENTAL INORGANICS/PHYSICAL TESTING PARAMETERS

### PARAMETER, (REF 1, 2, 3, 4, 5, 10)

### METHOD PERFORMED

ALKALINITY	310.1	
AMMONIA	350.1	$-\dot{c}\dot{b}$
BIOCHEMICAL OXYGEN DEMAND	405.1	-
BROMIDE	320.1	()
CHEMICAL OXYGEN DEMAND-LIQUID	410.1/508A	-
CHEMICAL OXYGEN DEMAND-LIQUID	5220	-()
	325.2/9252/300.0	()
CHLORIDE (LIQUID/SOLID)	110.1/110.2	()
COLOR (LIQUID/SOLID)	SW846/CHAP 7	-()
CORROSIVITY		()
CYANIDE, TOTAL (LIQUID/SOLID)	335.3/9012/4500 CD/CE	()
EXTRACTION PROCEDURE TOXICITY	1310	()
FECAL COLIFORM	9222D	()
HARDNESS	130.1	()
HEATING VALUE	353.2/9200/D2015	()
HEXAVALENT CHROMIUM	218.4	()
MOISTURE	D2216	()
NITRATE, NITROGEN (LIQUID/SOLID)	353.2/9200	().
NITRITE, NITROGEN (LIQUID/SOLID)	353.2/9200	()
ODOR (LIQUID/SOLID)	140.1/SM207	()
OIL AND GREASE	413.1	()
ORGANIC CARBON, DISSOLVED	415.1	()
ORGANIC CARBON, TOTAL	415.1	( )
PETROLEUM HYDROCARBONS	418.1,(REF 1,4)	()
рН	150.1/9045	()
PHENOLS, TOTAL (LIQUID/SOLID)	420.2/9066	· ( )
PHOSPHORUS, TOTAL	365.1	( )
REACTIVE CYANIDE	SW846/CHAP 7	()
REACTIVE SULFIDE	SW846/CHAP 7	()
REACTIVITY	SW846/CHAP 7	()
SPECIFIC CONDUCTANCE	120.1	()
SULFATE (LIQUID/SOLID)	375.4/9251/300.0	()
SULFIDE	376.1/9030	()
SULFUR	D4239	()
SURFACTANTS (LIQUID/SOLID)	425.1/SM512A	( )
TCLP SET-UP	EPA 1311	()
TOTAL COLIFORM (COLILERT METHOD)	SM9223B	( )
TOTAL DISSOLVED SOLIDS (LIQUID/SOLID)	160.1	( )
TOTAL ORGANIC HALOGENS	9020	( )
TOTAL SOLIDS	209F	( )
TOTAL SUSPENDED SOLIDS	160.2	( )
TOTAL VOLATILE SOLIDS	2540G	( )
WATER BY KARL FISCHER	4017	()
TOTAL KJELDAHL NITROGEN	351.3	( )
PHYSICAL TESTING-ASH	D3174	( )
PHYSICAL TESTING-SULFUR	D4239	( )
PHYSICAL TESTING-CHNO ANALYSIS	D5291	( )
FECAL COLIFORM, MF	9222D	()
MISC PARTIEWATE	EPA 5 & EPA 203	- Ù
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### **INDUSTRIAL HYGIENE PARAMETERS**

### AIR, (REF 6, 7, 8, 9)

### METHOD

### PERFORMED

VOLATILE ORGANICS BY GC/MS	EPA 18M	( )
PESTICIDES/PCBS BY GC	TO4	()
METALS	NIOSH 7300	( )
METALS	OSHA ID 121	( )
METALS	OSHA ID 125G	( )
METALS	40CFR, PT50, APPXG	()
MISC		( )
MISC	·	( )
MISC		( )

### **METHOD REFERENCES**

#### ALL METHODS ARE MOST CURRECT VERSION AVAILABLE:

(1) METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTE-600/4-79-002

- (2) SW846 TEST METHODS FOR EVALUATING SOLID WASTE
- (3) 40 CFR PART 136, VOL. 49, NO. 209 TEST PARAMETERS FOR THE ANALYSIS OF POLLUTANTS
- (4) AS MODIFIED BY NJDEP-BISE
- (5) STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER
- (6) EPA-450/4-87-022
- (7) 40 CFR PART 50, APPENDIX G
- (8) OSHA MANUAL OF ANALYTICAL METHODS
- (9) NIOSH MANUAL OF ANALYTICAL METHODS, (NMAM)
- (10) AMERICAN SOCIETY FOR TESTING AND MATERIALS, (ASTM) STANDARDS

# Laboratory Chronicle

	Lab	Analytical	Date		Date of	Date Of
	Sample ID	Method	Sampled	Rec'd	Prep	Analysis
, FILT #638, BHC,	1420084	EPA 5	9/12/00	9/19/00		9/25/00
	1420085	EPA 5	9/12/00	9/19/00		9/25/00
EP2000-FHA, FILT #636, BHC, BHS	1420086	EPA 5	9/12/00	9/19/00		9/25/00
000-FILT #6	1420087	EPA 5	9/12/00	9/19/00		9/25/00
FILT #641,	1420088	EPA 5	9/12/00	9/19/00		9/25/00
FILT #640, BHC,	1420089	EPA 5	9/12/00	9/19/00		9/25/00
, FILT #639, BHC,	1420090	EPA 5	9/12/00	9/19/00		9/25/00
ž D	1420091	EPA 5	9/12/00	9/19/00		9/25/00
Q.	1420092	EPA 5	9/12/00	9/19/00		9/25/00
л Ц	1420093	EPA 5	9/13/00	9/19/00		9/25/00
AF-M-LMF119-2-M202-12SEP2000-FHA, FILT #633, BHC, BHS	1420094	EPA 5	9/13/00	9/19/00		9/25/00
A202-12SEP2000-FILT #635	1420095		9/13/00	9/19/00		9/25/00
	1420096	EPA 5	9/13/00	9/19/00		9/20/00
EP2000-FHA, FILT #632, BHC, BHS	1420097		9/13/00	9/19/00		9/25/00
EP2000-FHA, FILT #631, BHC, BHS	1420098	EPA 5	9/13/00	9/19/00		9/25/00
	1420099	EPA 5	9/13/00	9/19/00		9/25/00
COMP: AF-N-LMF119-1-3-M202-12SEP2000-FILT #630, 631, 632	1420100	ĘPA 5	9/13/00	9/19/00		9/25/00
Filter W646	1421165	EPA 5		9/28/00		9/25/00
ilter W647	1421166	EPA 5		9/28/00		9/25/00
	1421167	EPA 5		9/28/00		9/25/00
	1420084	EPA 5	9/12/00	9/19/00		9/25/00
FILT #637, BHC,	1420085	EPA 5	9/12/00	9/19/00		9/25/00
. FILT #636, BHC,	1420086	EPA 5	9/12/00	9/19/00		9/25/00
FILT #641, BHC,	1420088	EPA 5	9/12/00	9/19/00		9/25/00
, FILT #640, BHC,	1420089	EPA 5	9/12/00	9/19/00		9/25/00
, FILT #639, BHC,	1420090	EPA 5	9/12/00	9/19/00		9/25/00
FILT #642, DCM, I	1420091	EPA 5	9/12/00	9/19/00		9/25/00
, FILT #634, BHC,	1420093	EPA 5	9/13/00	9/19/00		9/25/00
, FILT #633, BHC,	1420094	EPA 5	9/13/00	9/19/00		9/25/00
, FILT #632, BHC,	1420097	EPA 5	9/13/00	9/19/00		9/20/00
, FILT #631, BHC,	1420098	EPA 5	9/13/00	9/19/00		9/20/00
, FILT #638, BHC,	1420084	EPA 202	9/12/00	9/19/00		9/25/00
, FILT #637, BHC,	1420085	EPA 202	9/12/00	9/19/00		9/25/00
, FILT #636, BHC,	1420086	EPA 202	9/12/00	9/19/00		9/25/00
EP2000-FHA, FILT #641, BHC, BHS	1420088	EPA 202	9/12/00	9/19/00		9/25/00

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AF-I-LMF119-2-M202-12SEP2000-FHA, FILT #640, BHC, BHS	1420089	EPA 202 9/12/00 9/19/00	9/12/00	9/19/00	9/25/00
AF-I-LMF119-3-M202-12SEP2000-FHA, FILT #639, BHC, BHS	1420090	EPA 202	ł	9/12/00 9/19/00	9/25/00
AF-I-LMF119-SB-M202-12SEP2000-ACE, FILT #642, DCM, DIH20	1420091	EPA 202	9/12/00	9/19/00	9/25/00
EP2000-FHA, FILT #634, BHC, BHS	1420093	EPA 202	9/13/00	9/19/00	9/25/00
EP2000-FHA, FILT #633, BHC, BHS	1420094	EPA 202	9/13/00	9/19/00	9/25/00
AF-N-LMF119-1-M202-12SEP2000-FHA, FILT #632, BHC, BHS	1420097	EPA 202	9/13/00	9/19/00	9/20/00
AF-N-LMF119-2-M202-12SEP2000-FHA, FILT #631, BHC, BHS	1420098	EPA 202	9/13/00	9/19/00	9/20/00
EP2000-FHA, FILT #638, BHC, BHS	1420084	EPA 202	9/12/00	9/19/00	9/25/00
EP2000-FHA, FILT #637, BHC, BHS	1420085	EPA 202	9/12/00	9/19/00	9/25/00
EP2000-FHA, FILT #636, BHC, BHS	1420086	EPA 202	9/12/00	9/19/00	9/25/00
AF-I-LMF119-1-M202-12SEP2000-FHA, FILT #641, BHC, BHS	1420088	EPA 202	9/12/00	9/19/00	9/25/00
AF-I-LMF119-2-M202-12SEP2000-FHA, FILT #640, BHC, BHS	1420089	EPA 202	9/12/00	9/19/00	9/25/00
AF-I-LMF119-3-M202-12SEP2000-FHA, FILT #639, BHC, BHS	1420090	EPA 202	9/12/00	9/19/00	9/25/00
AF-I-LMF119-SB-M202-12SEP2000-ACE, FILT #642, DCM, DIH20	1420091	EPA 202	9/12/00	9/19/00	9/25/00
AF-M-LMF119-1-M202-12SEP2000-FHA, FILT #634, BHC, BHS	1420093	EPA 202	9/13/00	9/19/00	9/25/00
AF-M-LMF119-2-M202-12SEP2000-FHA, FILT #633, BHC, BHS	1420094	EPA 202	9/13/00	9/19/00	9/25/00
EP2000-FHA, FILT #632, BHC, BHS	1420097	EPA 202	9/13/00	9/19/00	9/20/00
EP2000-FHA, FILT #631, BHC, BHS	1420098	EPA 202	9/13/00 9/19/00	9/19/00	9/20/00

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Analyte articulate Weight - articulate Weight - articulate Weight - articulate Weight - articulate Weight - articulate Weight - articulate Weight -	ticulate Weight - ticulate Probe - Acetone Probe	Wt - Acetone Probe         Particulate Wt. Organic Fraction         Particulate Wt. Organic Fraction         Particulate Wt. Organic Fraction
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Page 3 of 4

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Particulate Wt. Organic Fraction Particulate Wt. Organic Fraction	te Wt. Organic Fraction		te Wt. Organic Fraction	te Wt. Organic Fraction	te Wt. Inorganic Fraction	e Wt. Inorganic Fraction	
Particulate Wt. Particulate Wt.	Particulate Wt.	Particulate Wt.	Particulate Wt.	Particulate Wt.	Particulate	Particulate Wt.	Particulate Wt.

Page 4 of 4

# Case Narrative/ Non-Conformance Summary Report

### Case Narrative/Non-Conformance Summary

Client Name: Roy F. Weston, Inc. Project Name: Lockheed Martin, GA/Method 202, WO#20054.006.001.2000 PAS Project #: 196995 Today's Date: October 10, 2000

This sample delivery group consisted of 20 samples collected on September 12-13, 2000. Samples were received intact on September 19, 2000 at the Philip Analytical Services Laboratory. Samples were logged into the Laboratory Information Management System (LIMS).

The samples were prepared and analyzed for Particulate by EPA 5 and EPA 202.

The following is a summary in narrative form of the quality control results associated with the samples.

### Inorganics:

Particulate-

• No problems encountered with the analysis of these samples.

Helen MacMinn, Quality Assurance Coordinator

## Analytical Sample Results for All Parameters/Final Report





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INDUSTRIAL HYGIENE

• EPA/NVLAP 101262-0 • AIHA ACCREDITATION NO. 100439

• NY DOH 10903 • PA DER 06-353

ENVIRONMENTAL TESTING

• NJ DEP 77678

### **ANALYTICAL REPORT**

Client: Report to:	Roy F. Weston, Inc. Pete Virag Roy F. Weston, Inc. 1400 Weston Way Building 5-1 West Chester PA 19380-	1499	Project: 196995 Received: 19-SEP-00 Reported: 18-OCT-00					
Copy to:	Jack Mills, Roy F. Weston, Inc							
Project Descr	iption: Method 202: USAF WO # 20054.006.0	/EQM, Lockheed   001.2000	Martin G <i>i</i>	4				
		RESULT	<u>UNITS</u>	<u>METHOD</u>	<u>DATE</u>	ANALYST		
AF-A-LMF119 Lab Sample: 14 sampled: 12-S		ILT #638, BHC, BH	<u>s</u>		~			
		< 0.1 1.8 0.5 1.4	mg mg mg mg	EPA 5 EPA 5 EPA 20 EPA 20		01A 01A 01A 01A		
AF-A-LMF119 Lab Sample: 14 sampled: 12-SI		<u>LT #637, BHC, BH</u>	<u>S</u>					
		< 0.1 1.4 1.6 3:9	mg mg mg mg	EPA 5 EPA 5 EPA 202 EPA 202		0LV 0LV 0LV		
AF-A-LMF119 Lab Sample: 14 sampled: 12-SE		<u>LT #636, BHC, BH</u>	<u>S</u>					
		< 0.1 1.1 0.9 1.3	mg mg mg mg	EPA 5 EPA 5 EPA 202 EPA 202		0LV 0LV 0LV		

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PHILIP			pag	e 2 of 4	180CT00_1142_0	03_N1146_RFR
		INDUSTRIAL H	YGIENE	ENVIRON	MENTAL TES	TING
ANALYTICAL SERVICES		• EPA/NVLAP 101262 • AIHA ACCREDITATIO		• NY DOH 10903 • PA DER 06-353	• NJ DEF	9 77678
Client: Roy F. W	/eston, Inc.					
Project: 196995		RESULT		METHOD	DATE	
			UNITS	METHOD	DATE	ANALYST
COMP: AF-A-LMF119-1 Lab Sample: 1420087	-3-M202-12SEI	<u> P2000-FILT #636, 63</u>	<u>7, 638</u>			
sampled: 12-SEP-00						,
Particulate Weight - Filte	er (	< 0.1	. mg	EPA 5	20-SEP-00	VJO
AF-I-LMF119-1-M202-1	2SEP2000-FHA.	FILT #641, BHC, BH	s			
Lab Sample: 1420088			-			
sampled: 12-SEP-00						
Particulate Weight - Filte	r	< 0.1	ma	EPA 5	20-SEP-00	VJO
Wt - Acetone Probe	4	1.9	mg mg	EPA 5 EPA 5	20-SEP-00 20-SEP-00	A10 A10
Particulate Wt. Organic	Fraction	0.8	mg	EPA 202	20-SEP-00	VJ0
Particulate Wt. Inorganic	Fraction	3.1	Ū	EPA 202	20-SEP-00	VJO
AF-I-LMF119-2-M202-1	2SEP2000-FHA,	FILT #640, BHC, BH	<u>s</u>			
Lab Sample: 1420089 sampled: 12-SEP-00 ⁻	<b>6</b>				·	
Particulate Weight - Filte	r	< 0.1	mg	EPA 5	20-SEP-00	VJO (
Wt - Acetone Probe		2.2	mg	EPA 5	20-SEP-00	VJO 3
Particulate Wt. Organic I		0.7	mg	EPA 202	20-SEP-00	VJO
Particulate Wt. Inorganic	Fraction	1.9	mg	EPA 202	20-SEP-00	OLV
AF-I-LMF119-3-M202-12	2SEP2000-FHA,	FILT #639, BHC, BH	<u>S</u>			
Lab Sample: 1420090 sampled: 12-SEP-00						
Particulate Weight - Filter	r	< 0.1	mg	EPA 5	20-SEP-00	VJO
Wt - Acetone Probe		2.2	mg	EPA 5	20-SEP-00	VJO
Particulate Wt. Organic F		0.6	mg	EPA 202	20-SEP-00	VJO
Particulate Wt. Inorganic	Fraction	1.7	mg	EPA 202	20-SEP-00	VJO
AF-I-LMF119-SB-M202-1 Lab Sample: 1420091	2SEP2000-ACE	, FILT #642, DCM, D	DIH2O			
sampled: 12-SEP-00						
Particulate Weight - Filter		< 0.1	mg	EPA 5	20-SEP-00	VJO
Wt - Acetone Probe		0.3	mg	EPA 5	20-SEP-00	VJO
Particulate Wt. Organic F		< 0.1	mg	EPA 202	20-SEP-00	OLV
Particulate Wt. Inorganic	raction	0.7	mg	EPA 202	20-SEP-00	VJO
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		pag	e 3 of 4	180CT00_1142_D	13_N1146_RFR
<b>PHILIP</b>	INDUSTRIAL H	GIENE	ENVIRON	IENTAL TES	TING
ANALYTICAL SERVICES	• EPA/NVLAP 101262- • AIHA ACCREDITATIC	0 NN NO. 100439	• NY DOH 10903 • PA DER 06-353	• NJ DEP	77678
Client: Roy F. Weston, Inc. Project: 196995					
	RESULT	UNITS	METHOD	DATE	ANALYST
COMP: AF-I-LMF119-1-3-M202-12SEP2 Lab Sample: 1420092 sampled: 12-SEP-00	000-FILT #639, 640	, 641			
Particulate Weight - Filter	< 0.1	mg	EPA 5	20-SEP-00	VJO
AF-M-LMF119-1-M202-12SEP2000-FHA Lab Sample: 1420093 sampled: 13-SEP-00	, FILT #634, BHC, BI	<u>15</u>			
Particulate Weight - Filter Wt - Acetone Probe Particulate Wt. Organic Fraction	< 0.1 2.5 0.7	mg mg mg	EPA 5 EPA 5 EPA 202	20-SEP-00 20-SEP-00 20-SEP-00	OLV OLV
Particulate Wt. Inorganic Fraction	1.7	mg	EPA 202	20-SEP-00	A10
AF-M-LMF119-2-M202-12SEP2000-FHA Lab Sample: 1420094 sampled: 13-SEP-00	<u>, FILT #633, BHC, BH</u>	<u>15</u>			
Particulate Weight - Filter Wt - Acetone Probe Particulate Wt. Organic Fraction	< 0.1 1.7 1.1	mg mg mg	EPA 5 EPA 5 EPA 202	20-SEP-00 20-SEP-00 20-SEP-00	
Particulate Wt. Inorganic Fraction	5.3	mg	EPA 202	20-SEP-00 20-SEP-00	OLV OLV
AF-M-LMF119-3-M202-12SEP2000-FILT # Lab Sample: 1420095 sampled: 13-SEP-00	<u>#635</u>				
Particulate Weight - Filter	< 0.1	mg	EPA 5	20-SEP-00	VJO
COMP: AF-M-LMF119-1-3-M202-12SEP2 Lab Sample: 1420096 sampled: 13-SEP-00	2000-FILT #633, 634	l <u>, 635</u>			
Particulate Weight - Filter	< 0.01	mg	EPA 5	20-SEP-00	OLV
AF-N-LMF119-1-M202-12SEP2000-FHA, Lab Sample: 1420097 sampled: 13-SEP-00	FILT #632, BHC, BH	<u>S</u>			
Particulate Weight - Filter Wt - Acetone Probe Particulate Wt. Organic Fraction Particulate Wt. Inorganic Fraction	< 0.1 1.4 1.4 3.3	mg mg mg mg	EPA 5 EPA 5 EPA 202 EPA 202	20-SEP-00 20-SEP-00 20-SEP-00 20-SEP-00	01A 01A 01A 01A

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	pa		ge 4 of 4	180CT00_1142_0	03_N1146_RFR
PHILIP	INDUSTRIAL HYGIENE		ENVIRONM	IENTAL TES	TING
ANALYTICAL SERVICES	• EPA/NVLAP 101262-0 • AIHA ACCREDITATIO		• NY DOH 10903 • PA DER 06-353	• NJ DEP	77678
Client: Roy F. Weston, Inc. Project: 196995					
	RESULT	UNITS	METHOD	DATE	ANALYST
AF-N-LMF119-2-M202-12SEP2000-FH/ Lab Sample: 1420098 sampled: 13-SEP-00	A, FILT #631, BHC, BH	<u>IS</u>			
Particulate Weight - Filter	< 0.1	mg	· EPA 5	20-SEP-00	VJO
Wt - Acetone Probe Particulate Wt. Organic Fraction	1.9 1.2	mg	EPA 5	20-SEP-00	· VJO
Particulate Wt. Inorganic Fraction	2.3	mg mg	EPA 202 EPA 202	20-SEP-00 20-SEP-00	OLV OLV
AF-N-LMF119-3-M202-12SEP2000-FILT Lab Sample: 1420099 sampled: 13-SEP-00 Particulate Weight - Filter COMP: AF-N-LMF119-1-3-M202-12SEI Lab Sample: 1420100 sampled: 13-SEP-00	< 0.01	mg <u>, <b>632</b></u>	EPA 5	20-SEP-00	OLV
Particulate Weight - Filter	< 0.01	mg	EPA 5	20-SEP-00	VJO.
<u>Filter W646</u> Lab Sample: 1421165					
Particulate Weight - Filter	- 0.19	mg	EPA 5	20-SEP-00	VJO
Filter W647 Lab Sample: 1421166					
Particulate Weight - Filter	- 0.11	mg	EPA 5	20-SEP-00	OLV
<u>Filter W648</u> Lab Sample: 1421167					
Particulate Weight - Filter	- 0.18	mg	EPA 5	20-SEP-00	OLV

< Indicates less than the limit of quantitation.

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# Inorganics Raw Data (Lachat, IC, nonautomated)

Lab No.:  Client:	WINK	196995 9-1-M202 12-SEP-0 19-SEP-0	Roy F. Westor 12SEP2000-FHA 0 14:35	n, Inc. Due: 26-SEP-( A, FILT #638, BHC, BHS	olved .	9  2 9	000 (1	Soo H	RS
Description	n			Inorgan	nie Fr	ortion	,		
A. Sampl	e Volume		wash		390	_mls _mls	Blank Correction		
Total:	390	)	ml ×	2×10-6	g/ml -	0	008	}	
B. Tare V	Veights Continer: _	115.	1603	g			No		
	Filler:	110		_a		Container	NO.		
	Thimble:			_9					
	Total:			_a					
C. Gross Dale	Weights 9 23 01 9 25 00	(1) (2) (3)	115.16	Date		(4) (5) (6)			
		X.		Final Gross Weigh Tare Weight: Residue Weight: Blank Weight:	t: <u>  5</u> 5	· 1625 · 1603 · 0022 · 0022 · 008	g	ື ວ ອ ອ ອ	
D. Net W	Veights: Remarks:						<u> </u>	-	
				Analys	t JB	100			

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				Pn	o. No.: _			
Lab No.:	1420084	196995	Roy F. Westo	n. Inc.	-	ved	91	20/08
Client:	MUNK AF-A-LMF1 Sampled: Received:		-12SEP2000-FH/ 0 14:35	_	_	· •		9/25/00
Description					Org	anie	Frae	lion
A. Sample	e Volume			_		30	mls	
			wash .		<u></u>	150	mls	Blank Correction
Total:	180		ml x			_g/m1 -		g
B. Tare V	/eights					*		
	Continer:	107,	1515	g		[	Containe	No.
	Filter.			_g				
	Thimble:			<u>9</u>				
	Tolai:			_a				
C. Gross	Weights			ł	Date			
Dale	4/25/06 9/25/00	(1) (2) (3)	107.153 107.15				(4) (5) (6)	
				- Final Gross	s Weight:	107.	1520	g
				Tare Weig Residue W		107.	1515	R
D. Net W	/eights: Remarks:			Blank Wei				g
					Analyst	JB	100	

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		Pm Nn'	· · · · · · · · · · · · · · · · · · ·	
Lab No.: 142008	B4 196995 Roy F.	Weston, Inc.	1	1/20/00
Client: WUNK AF-A-L Samp Receiv	LMF119-1-M202-125EP2 led: 12-SEP-00 : ved: 19-SEP-00 14:3	Due: 26-5 2000-FHA, FILT #638, BHC, 25	EP-0 BHS	9 /25/00
Description		Pr	ohe Ace	lone
A. Sample Volume			フち _{mls} ろう _{mls}	Blank
	wash	3×10-6	g/ml, O	Correction
Total:	ml x رو			
B. Tare Weights	-			~
Continer:	95.4735	9	Contain	er No.
Filler:		g		
Thimble:		g		
Totał:		9		
C. Gross Weights		Date		
Date <u>9122/06</u> 9123/00	$\begin{array}{c} (1) & \frac{9}{75.4} \\ (2) & \frac{75.4}{75.4} \\ (3) & \end{array}$	1756	(4 (5 (6	5)
		Final Gross Weight Tare Weight: Residue Weight:	95.47	<u>91</u> <u>12</u> a
		Blank Weight:	. 0.00	939
D. Net Weights: Remarks:	:		· 00	18
		Analys	J0 /V	D
r				

Lab No.:  Client:	14200			ston, Inc. Due: 26-SE		9	20/00
	AF-A-I Samp] Receiv	.MF119-1-M led: 12-SE /ed: 19-SE	202-125EP2000 2-00 P-00 14:35	-FHA, FILT #638, BHC,	BHS I		7/27/00
-							
Description	• -			ŀ	Filter	- 6:	38
A. Sample	e Volume			<u></u>		mls	
A. Sampr							Dlack
			wash		. <u></u>	mis	Blank Correction
Total:		i	ml x		_g/ml -		ĝ
B. Tare V	Veights		_		-		
	Continer:	·		ð			No
	Filler.	0.1	9912	g		Container	110.
			<u>/ (0</u>	- ⁻ 9			
	Thimble:			-	<u></u>		
	Tolal:			_9			
C. Gross	Weights			Dale			
Date	9122/00	(1)	01943	S		(4) (5)	
	9/25/00	(2) (3)	0.19.39	-		(6)	
	- :00	- 474	•	Final Gross Weight			
				Tare Weight: Residue Weight:	•		{
				Blank Weight:			
D. Net W	/eights: Remarks:						
				Analyst	JH	110	, <b>i</b>

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Lab No.	1420085	196995	Roy F. Westor	, Inc. :		1
Client:	WUNK AF-A-LMF11 Sampled: 1 Received:	2-SEP-00	:	Due: 26-SEP-004 A, FILT #637, BHC, BHS I 1:		- 100  25 00
Descriptio	n			Im	nganic From	Tion
A. Samp	le Volume				375 mls	
			wash		mls	Blank Correction
Total:	- 37	5	mi x	2×10-6	_g/ml0	008_g
B. Tare V	Veights			-		
	Continer:	108.	5920	_ ⁹	Container	No.
	Filter:			_a		
	Thimble:			_g		
	Total:			_9		
C. Gross Date	-		108.596	Date	(4)	
	9 25 60 9 35 60	(1) (2) (3)	105.59		(5)	
				Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	108 5967 108 5920 0047 .0608	9 9 9 9
D. Net W	eights: Remarks: .				. 6039	
			<u></u>	Analyst	JB / VO	

Lab Nc	1420085	196995	Roy F. Weston,	Inc.	).:		
Client:	WUNK AF-A-LMF1 Sampled: Received:	19-2-M202 12-SEP- 19-SEP-(	2-12SEP2000-FHA, 00 : 00 14:35	Due: 26-9 •FILT #637, BHC, —	BHS BHS ut:	ı <u>9</u> /	20/00 9/25/00
Descriptio				_			
				0,	iganic	- Froil	ion
A. Samp	le Volume	3	<u></u>		0	3 ø_mls	
<u></u>			wash			150 mis	Blank Correction
Total:		180	mix		g/n	ni	g
B. Tare V	Weights		-				-
	Continer	. 118	376/	_9	<b></b>	Contain	er No.
	Filter:			_g			
	Thimble:			_9	L		
	Total:		<u> </u>	_9			
C. Gross Date				Da	fe		
	9 23 00 9 23 0		) 1/9.37			(4) (5) (6)	
	-	(0		– Final Gross V Tare Weight:		118.377	7g
D. Net W	'eights: Remarks	5:		Residue Weig Blank Weight	-	. 00]	<u>p                                    </u>
				Ar	nalyst	JP IV	)



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Lab No.:					Pm. No.:			
	1420085	196995	Roy F. Westo	n, Inc.				20/00
Client:	WUNK AF-A-LMF1 Sampled: Received:	19-2-M202- 12-SEP-00 19-SEP-00	-128ED2000_FU		Due: 26-SEP-0 #637, BHC, BHS 	vived		1/25/00
Descriptio	n				Pro	he A	cetore	
A. Sampl	e Volume					70	mls	
			wash	<u></u>		25	mls	Blank Correction
Total:		[00	_ml x	3	X10-9	_g/ml -	<u> </u>	9g
B. Tare V	Veights					-		
	Continer:	104.	7725	9		· · ·	Containe	r No.
	Filter:			g				
	Thimble:			9				
	Total:			g				
C. Gross Date	Weights <u>9/2400</u> <u>9/3/00</u>	(1) (2) (3)	104.77		Dale		(4) (5) (6)	
D. Net We	eights: Remarks:	-		Tare V Residu	Gross Weight: Veight: ue Weight: Weight:	<u> </u> 6 <u> </u> 6	4.774 <u>4.772</u> .001 .000	79 39
	•							

Analyst

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Lab No.:	1420085	196995	Roy F. West	en 1-	••				
Client:				Due HA, FILT #637,	: 26-SEP-0 BHC, BHS	eived	9	120/00 7. 25/00	•
Descriptio	<u></u>			, <u></u> ,	•				•
					<u> </u>	ter_	-637		•
A. Samp	ie Volume					-	mls		
			wash		<u> </u>		mls	Blank Correction	l
Total:			mlx		<u></u>	_g/ml -			_g
B. Tare V	Veights			<b>A</b> 4	•				
	Continer:			_9		r	Container	No	1
	Filter:	0.2	10989-	g			Commenter	110.	
	Thimble:			g					
	Total:		- <u> </u>	9					
C. Gross Date	Weights				Date				
Date	<u>9172/00)</u> 1125/00	(1) (2) (3)	<u>0:1989</u> p. 198				(4) (5) (6)		
	- 0	. 00 3	85	Final Gros Tare Weig					
				Residue V Blank Wei	Veight:				_
D. Net W	eights: Remarks:	<u> </u>							_
					Analyst	_			
		•			-	Л	Vo		

Lab N  Clier		-M202-125	F. Weston, I EP2000-FHA, F 4:35	[−] No.: nc. Due: 26-SEP-0 [?] eca ILT #636, BHC, BHS Dut:		9/20, 9/	100 25/00
Descript	ion			Inorga	i Fi	action	
A. Sam	ple Volume			<u></u>	458		
			wash			_mls	Blank Correction
Total:	43	50	ml x	2×10-6	_g/ml -	. 00	09_g
B. Tare	Weights	-	-				*
	Continer: Filter: Thimble: Total:	97.	8864	_a _a _a		Container N	10.
C. Gros Date	s Weights 9 23 06 9 25 00	(1) (2) (3)	97.8886	Date		(4) (5) (6)	
D. Net V	Weights: Remarks:			Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	97	0.8884 - <u>8864</u> - <u>00</u> 27 - <u>00</u> 9 - <u>00</u> 9	9 9 /9

Analyst

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Lab		Pro. No.:			
Clie	1420086 196995 Roy F. Weston, WUNK	Rece	ived	9/2	0/00 125/20
	AF-A-LMF119-3-M202-12SEP2000-FHA, Sampled: 12-SEP-00 : Received: 19-SEP-00 14:35	FILT #636, BHC, BHS	<u></u>	. 9	25/20
Descrip	otion	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
		- O Aa	fance	Fiarl	lion
A. San	nple Volume			mis	
	wash		150	_mls	Blank Correction
Total:	706ml x	<b></b>	g/ml -		g
B. Tar	e Weights		-		
	Continer: 101. 2279	9	r	Container I	
	Filter:	9		Container i	<b>NO</b> .
	Thimble:	g			
	Total:	9			
	ss Weights	Date			
Date	9-23-00 (1) 101,22	<u>9</u> 3		(4)	
	<u>9-23-06</u> (2) <u>101.2</u> (3)	<u> </u>		(5) (6)	
		Final Gross Weight:		. 2288	
		Tare Weight: Residue Weight:		1. 2279 .000 <b>9</b>	9
		Blank Weight:		1	
D. Net	Weights: Remarks:				

Analyst

JB/VO

Lab 1420086	196995 Roy F. Weston, I	- No.:		
- · · · · · · · · · · · · · · · · · · ·	19-3-M202-12SEP2000-FHA, F 12-SEP-00 19-SEP-00 14:35		eived <u>9/</u> 6 9	)0/06  25/20
Description		P	cobe Actone	
A. Sample Vol	ume	<b></b>	30_mls	
	wash	<u></u>		Blank Correction
Total:	155 ml x	3×10-4	_g/ml0 0	<u>05</u> 9
B. Tare Weigh	ts	~		-
	iner: <u>[00.437]</u> r:	a a a	Container No	).
Total	:	g		
C. Gross Weigl Date 9/2 9/3	hts 2 <u>[00]</u> (1) <u>[10:43</u> <del>3]00</del> (2) <u>[00:4]</u> (3)	Date 27 39 3	(4) (5) (6)	
D. Net Weights: Rem	arks:	Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	100. 4387 100. 4371 -0016 -6005 -0011	9 9 9 9
		·····		

Analyst

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Lab No	1420086 1	96995 Ro	oy F. Weston,	Inc.	•			10 100
Client:	WUNK AF-A-LMF119 Sampled: 12 Received: 1	-3-M202-12 2-SEP-00 9-SEP-00	25EP2000-FHA, 14:35	Due: 2 FILT #636, B	6-SEP-O(Cel HC, BHS 4:	ved		20/00 7/25/co
Description	۰ 				F.	itor	- 63	ίο
A. Sampl	e Volume						_mls	
			wash		-		mls	Blank Correction
Total:			_ml x			g/ml -		g
B. Tare V	Veights				*	• .		
	Continer:		<u></u>	g		f	Container	No
	Filter:	0.19	1986	g			Container	
	Thimble:			9				
	Total:			g				
C. Gross Date	Weights <u>9/22/00</u> <u>9/25/00</u>	(1) (2)	<u>01987</u> 0.1988	.7 0	Date		(4) (5) (6)	
	-	(3) . <i>0</i> .00	, i o & g	Final Gross Tare Weigh Residue W Blank Weig	eight:			9 9 9
D. Net We	eights: Remarks:				,			
		<u> </u>			Analyst	JP	100	

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Lab No.:	1420087	196995 Roy F. West	on, Inc.				
Client:	WUNK COMP: AF- Sampled: Received:	A-LMF119-1-3-M202-125 12-SEP-00 19-SEP-00 14:35	° ≱ived	ived <u>9/20/00</u> 9/27/00			
Description	ייייייייייייייייייייייייייייייייייייי						
			<u></u>	titter	- 636	, 637,	638
A. Sample	e Volume					mls	
		wash				mls	Blank Correction
Total:		ml x	<u></u>		g/mi -		g
B. Tare W	leights	-					-
	Continer:	0.19984	_g			Container	No
	Filter:	0.20282-	_g			Container	NU.
	Thimble:	0. i9917	_9				
	Total:	0.60180	g				
C. Gross V Date			_	Date			
-	9 26 00	(1) $7.589$ (2) $0.592$ (3)	[]- [9			(4) (5) (6)	
-	- A-	01243	- Final Gr	oss Weight	·		
		009619	Tare We Residue	ight: Weight:	<u></u>		Q
D. Net Wei	ights: Remarks: _		Blank W	eign:			
	-		<u></u>	Analyst	JH	100	

Lat 1420088 196	995 Roy F. Weston, Inc	. No.:		
Clin WUNK	I-M202-12SEP2000-FHA, FIL -SEP-00 : -SEP-00 14:35	Due: 26-SEP-0 T #641, BHC, BHS: Rece	ived	1/20/00
AF-I-LMF119-1 Sampled: 12	-M202-125222000 1141, 000 -SEP-00 : -SED-00 14:35	a Out:		9/25/00
Received: 17		-		
Description				
		Inorg	anie Frai	tor
<u></u>		0		
A. Sample Volume	ż		380 mls	
	wash		mls	Blank Correction
Total: 3	हुए mix	2+10-6	_g/ml	0008 g
B. Tare Weights				
Continer	: 113-11 <b>3</b> -3-2-	_g	0.45	
Filter:	113.4342	g	Contair	er no.
Thimble:		g		
		-		
Total:		_9		
C. Gross Weights Date		Date		
9-25-0			(4	
<u> </u>	(3)		((	
		Final Gross Weight:		
		Tare Weight: Residue Weight:	113.43	<u>42-</u> 9 39 9
		Blank Weight:	. 00	والمتحدث والم
D. Net Weights: Remark	s:		. 00	31 7
		<u></u>	······································	-
		Analyst	JOIK	/
			/ 0	

Lab N	1420088 196995 5		Pro. No.:		
	WINC - ROY	F. Weston, 1	nc. Rece	ived _	9/20/00
	AF-I-LMF119-1-M202-12SE Sampled: 12-SEP-00 Received: 19-SEP-00 14:	^{92000-FHA, F1 35}	Due: 26-SEP-0(Out: #641, BHC, BHS		9/25/0
Descripti			ا ر ن	rganic	
Descripti			Free	nganic.	Fraction
A. Samj	ple Volume			25	
		_wash		150	mls Blank Correction
Total:	175	_mi x		g/ml -	9
B. Tare	Weights		<b>~</b>	• •	
	Continer: 101.0	364	9		·
	Filter		- g	C	ontainer No.
			•		
	Thimble:		.g	L	
	Total:		g		
	s Weights		Date		
Date	4/23/00 (1)	101.03	74		(4)
	<u>9  23  0:</u> (2) (3)	101.03	72	<u></u>	(5) (6)
		<u></u>	-	101.0	372 g
			Final Gross Weight: Tare Weight:	101.0	364 9
			Residue Weight: Blank Weight:	· (	9 <u>9 008</u> 9 <u>9</u>
D. Net W	/eights: Remarks:				
					· ·

Analyst

JB/VO

Labt	1420088 19699	75 Roy F	. Weston, In	nc.	'o.: _		9	2-1	
Clien	WUNK AF-I-LMF119-1- Sampled: 12-SE Received: 19-SI	P-00 :		Due: 20 ILT #641, B	HC, BHS Jut:	ved		90/00 9/25/00	
Descripti	on	· · · · · · · · · · · · · · · · · · ·			Pro	rhe #	leto	بالم	
A. Sam	ple Volume				<u> </u>	60	mls		
			wash			25	mls	Blank Correction	
Total:	85	-	ml x	3	x10-b	g/mi -	• 0	003	g
B. Tare	Weights	*						-	
	Continer:	111.80	00	9			Container	No.	
	Filter:			_ ^g					
	Thimble:			_9					1
	Total:			_g					
C. Gros Date	s Weights 9   77   06 9   23   00	(1) (2) (3)	///.802, 1//,802	2	Date		(4) (5) (6)		•
D. Net	Weights: Remarks:			Final Gro Tare We Residue Blank W	Weight:	<u>)//.</u>	5022 5005 0022 0003	z	
	-								-

Analyst

108 JB

Lab N	1420088 196	995 Roy F. We	ston, Inc.	D.:				
Client	WUNK AF-I-LMF119-1 Sampled: 12- Received: 19-	-M202-12SEP2000 -SEP-00 -SEP-00 14:35	D -FHA, FILT #64	Due: 26-SEP-Oteceiv FILT #641, BHC, BHS 		9  20  00 <b>9  27  </b> 00		
Descript	ion _		<u> </u>			- ( 11		
			<u></u>	<u>۲</u>	itter	- 641		
A. Sam	ple Volume					mls		
		was	h			mls	Blank Correction	
Total:		ml :	×		_g/ml -		g	
B. Tare	Weights				-			
	Continer:		g		<b></b>	Questainer	No	
	Filter:	0.200	<u>99</u> g			Container	NO.	
	Thimble:		g					
	Total:		g					
	s Weights			Data				
Date	9/22/00	$\begin{array}{c} (1)  \begin{array}{c} 0 \cdot i \\ \hline \end{array} \\ (2)  \begin{array}{c} \hline \end{array} \\ \end{array}$	20012	Date		(4)		
	~	(3)		•		(6)		
	~	0.00054		Gross Weight: Weight:			9 9	
			Resid	lue Weight:			g	
D. Net V	Veights: Remarks:		Blank	Weight:				
			<u></u>	<u> </u>				
				Analyst	Тн	/ Vo		

	1420089 19699	5 Roy F. Wes	ston, Inc.	lo.:		
Labl	WUNK AF-I-LMF119-2-M2	202-125EP2000-	E FHA, FILT #6-	Due: 26-SEP-0 40, BHC, BHS	ived	9/20/06
Clier	Sampled: 12-SE Received: 19-SE	2-00 14:35		Date Out:		9/25/00 9/25/00
Descript	ion			Inore	Junic Fli obs A ceto	ictor
				+>	whe A leto	
A. Sam	pie Volume				<u>375</u> mis	
		was	sh		mls	Blank Correction
Total:	375	ml	x	2×10-4	_g/ml -	.0008 g
B. Tare	Weights			<b>م</b> ر .		
	Continer:	08.286	<u>و م</u>		Conto	iner No.
	Filter:		g		Conta	
	Thimble:	. <u>.</u>	g			
	Total:		g			
C. Gros Date	s Weights			Date		
Dale	9-25-00 9-25-00		8.2893			(4)
		(3)				(6)
				I Gross Weight: Weight:	108.25	
			Res	idue Weight: hk Weight:	· 0	027 9 008 9
D. Net V	Weights: Remarks:	<u></u>			the second s	0619
				<u></u>		
				Analyst		17
•				, alory 50	JP /	Vr ·

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Lab Nr	1420089 1	96995	Roy F. Weston,	Inc.	».:			
Client:		-7-M707	-125FP2000-FHA.	<b>Συρ</b>	26-SEP-Oece BHC, BHS ut:		<u>9]</u> 9	20/00
Descriptio	n				Urg	unic	Frank	or .
A. Sampl	le Volume						mis	
			wash	<u></u>		150	mls	Blank Correction
Total:		<u>15</u>	ml x	<u></u>		g/ml -		g
B. Tare V	Veights	-	-				-	•
	Continer:	114	.4155	_g		· · · · ·	Container	No.
	Filter:			9				
	Thimble:			g				
	Total:		<u></u>	_g				
C. Gross	Weights				Date			
Date	9/23/06 9/23/00	(1)	) 114,416	с 2	Dale		- (4) - (5) - (6)	
		(3)		-	oss Weight:	114.	_ (0) 4162	g
				Tare We Residue	Weight:	114.	4155	ð
D. Net We	eights: Remarks:			Blank W	eight:			g
					Analyst	JВ	1 00	

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Lab N	1420089 196	795 Rov	F. Weston, 3	Ing	~~ No.:			
Clienf	WUNK AF-I-LMF119-2- Sampled: 12-S Received: 19-5				26-SEP-0 BHC, BHS Dut:	ived	9/2 9/	000
Descriptio					·	he Acel	lone	
A. Samp	ble Volume					50	mis	
<u></u>			wash			25	mls	Blank Correction
Total:	7	5	_mi ×	3.	× 10-4	_g/m1 -	. 0	002 g
B. Tare	- Weights					-		
	Continer:	162.7	1532	_8		<b>[</b> ]	Container N	Jo.
	Filter:			_g			Oundamer 1	
	Thimble:		<u></u>	_ ^g				
	Total:			_g				
C. Gross Date	s Weights 	(1) (2) (3)	102.75 102.75	559	Date .		(4) (5) (6)	
				Tare W Residu	ross Weight: /eight: e Weight: Weight:		2.755 2.753 .002 .000	2 g 4 g 2- g
D. Net V	Veights: Remarks:						. 002	<u> </u>
		·			Analyst	JB	/ v	΄∂

Lab No	1420089	196995	Roy	F. Weston,	Inc.					
Client:	WUNK AF-I-LMF11 Sampled: Received:	12-SEP- 12-SEP- 19-SEP-(	2-125 00 00 1	EP2000-FHA, 4:35	FILT	Due: #640,	26-SEP-0 BHC, BHSice		9	20/00 9/21/00
Descriptior	ı						Fit	toc -	640	
A. Sample	e Volume								mis	
		<u></u>		wash				. <u> </u>	mls	Blank Correction
Total:				_ml x				g/ml -	<u></u>	g
B. Tare W	/eights	*							•	*
	Continer				_g			[	Containe	No.
	Filter:	0.2	<del>)</del> 0(	242	_9				<b>O</b> OIRCE.	
	Thimble:				_g					
	Total:				_g					
C. Gross Date	Weights व्। २२ वे/ २८		) 2) 9)	01997	ן יי 		Date		(4) (5) (6)	
	- 0	. 663	27	ŀ	Tai Re:	re We	Weight:			( ) (
D. Net We	eights: Remarks	5:					<u></u>			
							Analyst	JH	دم/	

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Lab No	1420090	196995	Roy F. Weston,	Inc	- •'י:	<u></u>		
Client:	WUNK	19-3-M202	-125FD2000-FH0	Duce	26-SEP-0( ^{)CC} BHC, BHS bt:	ived		)000  25 00
Descriptio	n	<b></b>			Inorg	anic	Fiarto	س
A. Sampl	e Volume	<u> </u>					mls	
			wash				mis	Blank Correction
Total:	37	15	m x	2×	10-4	_g/mi -	. 0 .	207 g
B. Tare V	- Veights					**		
	Continer:	109,	3194	_ð		r	Container	No.
	Filter:			g			Container	
	Thimble:			_9				
	Total:			_9				
C. Gross Date	Weights 9 22 04 9 25 04		109.32		Date		(4) (5) (6)	
D. Net W	eights: Remarks			Final Gro Tare We Residue Blank W	Weight:		9.3218 9.3794 • 0034 • 0034 • 007	9
					Analyst	T.3	1 10	

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Lab N	1420090	196995	Roy	F. Weston,	Inc.		o.:			
Client	WUNK AF-I-LMF1:	19-3-M20 12-SFD-	2-125	EP2000-FHA,	FILT	Due: #639,	26-SEP-0 BHC, BHS≀ece	ived	<u> </u>	125/00
	Sampled: Received:	19-SEP-	ŎŎ 1	4:35			Jut:		7	00
							•			
Descriptio	ก	<u></u>					Ол	janic	Froe	tion
A. Samp	le Volum						(	_	mls	
•				weeh				158	mis	Blank
				wash					_	Correction
Total:		200		_ml x	<u></u>			_g/ml -		g
B. Tare	Weights	-		*						
	Contine	er. <u>1</u> 0	1.4	960	_g				Container	No
	Filter:				g				Container	
	Thimble	e:			g					
	Total:				g					
	: Weights	i					Date			
Date	9/23/0		(1)	101.4	969	7	Dale		- (4) (5)	
	<u>9 23 </u> 		(2) (3)	101.4	Y 	0			(6)	
					• •		ross Weight:		1.496	
					R	esidu	eight: e Weight:		. 000	
D. Net W	/eights: Remar	ks:			BI	ank V	Veight:			a
							Analyst	JB	VZ	



Lab N					No.:			
Ladiv	1420090 1969	75 Roy	F. Weston, 1	inc.	-	d	9120	100
Clien	WUNK AF-I-LMF119-3-1 Sampled: 12-SE Received: 19-Si	1202-1258 P-00 EP-00 14	P2000-FHA, F 1:35	Due: 20 TLT #639, B	S-SEP-0( HC, BHS Dut: _	ved -		27/00
Descripti	on				[.	robe K	leto	l
A. Sam	ple Volume				(	130	mls	
			wash			25	mls ·	Blank Correction
Total:	155	-	_ml x	3×10	,- 4	g/ml -	_ 00	0 <u>5</u> g
B. Tare	<i>∽</i> Weights					-		
	Continer:	118.9	1712	_a			Container N	10.
	Filter:			_g				
	Thimble:			_ ^g				
	Total:			_9				
	s Weights				Date			
Date	9/22/00	(1) (2) (3)	<u>118.97</u> 118.97				(4) (5) (6)	
		(0)	<u></u>	- Final Gro	oss Weight:		- 9739	g
•				Tare Wei Residue	ight:	118.	9712	að
				Blank W		······	.0005	g
D. Net \	Weights: Remarks: _						6600,	д
	-	<u>,</u>			Analyst	JB	100	

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La'		Pro. No.:			
1420090 196995 Cl WINK	5 Roy F. Weston, Inc 02-12SEP2000-FHA, FIL -00 : -00 14:35	:. s Rece Due: 26-SEP-0 T #639, BHC, BHS e Out:			120/00 02/100
Description				- 639	
A. Sample Volume		<u>_</u>		mis	
	wash			mls	Blank Correction
Totai:	ml x	<u></u>	_g/ml -		g
B. Tare Weights	<b>.</b> .				*
Continer: Filter:	0.20618	_9		Container	No.
Thimble:		_g			
Total:		_g			
C. Gross Weights Date <u>9/22/00</u> <u>9/35/00</u>		Date 7() 9.3		(4) (5) (6)	
-	0 00025	Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	0.		99 99 9
D. Net Weights: Remarks:					
		Analyst		רע	

			Dm No.;	
Lab No.	1420091 196995 1	Roy F. Weston, I	nc	9120/00
Client:	WUNK AF-I-LNF119-SB-M202 Sampled: 12-SEP-00 Received: 19-SEP-00	12SEP2000-ACE, 14:35	Due: 26-SEP-0 FILT #642, DCM, DII	ed <u>9 20/00</u> 9 25/00
Description			In	organic Fraction
A. Sample	e Volume			295 mls
		wash		mls Blank Correction
Total:	295	ml ×	295	g/ml - 2×10-6 g
B. Tare V				
	Continer. 106	4605	g	Container No.
	Filter.		9	
	Thimble:		9	
	Total:		g	
C. Gross Date	Weights <u>9 23/0c</u> (1) <u>9 23/0c</u> (2) (3)	106.44	Date 1 3	(4) (5) (6)
			- Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	106.4612
D. Net V	Veights: Remarks:			
			Analyst	J3 / Vo

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				Pro. No.:			
Lal. Nº 14 Clica: M AF Sa	INK		Weston, Inc. 2000-ACE, FIL	Due: 26-SEP-01 ^e Rec T #642, DCM, DI Ie Out:		9 9	120/00
Re	·	-00 14:35	) .				
Boothpar	-			Ол	ganie	Fro	tion
A. Samp	ble Volume				40	•	
			wash		158	mls	Blank Correction
Total:		16	_ml ×		g/ml -		g
B. Tare	Weights			*		· •	
	Continer:	112.	7870	_g		Container	No.
	Filter			_g			
	Thimble:			_9			
	Total:			_g			
C. Gros Dale	s Weights	· .		Date		(4)	
	9-23-60	(1) (2)	112.786	<u>•</u> 7		- (4) - (5) - (5)	
		(3)		-		(6)	
				Final Gross Weigh Tare Weight:	1:		Q
				Residue Weight: Blank Weight:			9 9
D. Net	Weights: Remarks:						
				<u> </u>			
	15			Analys	TB	100	·
					/		

			Partic	culate A	nalys	15				
Client:	1420091 19699 WUNK AF-I-LMF119-SB Sampled: 12-S Received: 19-S	-125	. Weston, In 192000-ACE, F 135	C. Dua: 26-9	GEP-0 ⁹ celvi 1, DII ut:	əd	C	1  20  9/2	5/00	
Description					Prohe	Act	tone	2		
A. Sample	e Volume		wash		• 	80 75	_mls _mls	C	Blank Correction	l
Total:	103	5	_ml×		105	g/ml -		3×10	- 6	_ð
B. Tare V	Veights Continer: Filter: Thimble: Total:	105.2	3148	_a _a _a			Conta	ainer No	).	
C. Gross Date	s Weights 9/2400 9/23/00	(1) (2) (3)	<del>105-31</del> 	1	ght: Neight:	9 22  9 23 -9 23 -9 23 	3/00 100 105.	(4) (5) (6) 3/5/ 0603	105.3	5     <u>75</u> 2- 9 9 9
D. Net V	Weights: Remarks:									
					Analyst	JB	12	6		

Lab No.	1420091	196995				(	1/20/00
Client:	WUNK AF-I-LMF1 Sampled: Received:	19-SB-M2 12-SEP-0 19-SEP-	02-12SEP2000-ACE 00 : 00 14:35	Due: 26-5EP-0,c , FILT #642, DCM, DI ן א		9	127/00
Description					Fitter.	-642	
- A. Sample	Volume					mls	
<u></u>			wash		<u> </u>	mis	Blank Correction
Total:			mi x		g/ml -		g
B. Tare W	/eights		*				-
	Continer	:		_8	<b></b>	Container	No.
	Filter:	0	.20361	_8			
	Thimble	:		_g	L		
	Total:			_g			
C. Gross Dale	Weights <u>9/27/</u> <u>9/25/</u>	$\frac{00}{00}$	1) 0,2020 2) <del>6,201</del>	Date		(4) (5) (6)	
		<u> </u>	3)	 Final Gross Weig Tare Weight: Residue Weight:	······································		8 8
D. Net W	leights: Remar	ks:		Blank Weight:			
				Analy	รt JH	10	

Lab	420092 19699	5 Roy F. Weston, II	NO.:		
Clier _		19-1-3-M202-12SEP200	Due: 26-SEP-ORect 0-FILT #639, 640, (	eived	9/20/00
R	Sampled: 12-Si teceived: 19-SE	p-00 14:35	GH Out:		9/27/00
Descriptio					
			Filter	- ±639,	40,44
A. Samp	le Volume	•		n	nls
		wash		n	nls Blank Correction
Total:		ml x		_g/ml	g
 B. Tare	Weights				
	Continer:	0.20618	_ ⁹		ontainer No.
	Filter:	0.20242	g		
	Thimble:	0.20341	_g		
	Total:	0.61221	_g		
	; Weights		Date		
Date	1126/00	(1) <u>0.604</u> (2)			(4) (5) (6)
	- 0.	003499	- Final Gross Weight:		
			Tare Weight: Residue Weight: Blank Weight:		
D. Net W	/eights: Remarks:				
	-		Analyst		100



		No.:	
Lab 1201 1420093 196995	Roy F. Weston, Inc.	Due: 26-SEP-0Received	9120100
Clion:: MUNK AF-M-LMF119-1-M2( Sampled: 13-SEP- Received: 19-SEP	02-12SEP2000-FHA, FILT 00 -00 14:35	#634, BHC, BHS Out:	9 24/00
Description		Inng	ance Fraction
A. Sample Volume			475 mis
	wash		mls Blank Correction
Total: 475	ml x	2×10-4 9	/ml9
B. Tare Weights			
Continer:	106.5257	. ⁹ Г	Container No.
Filler.		9	
Thimble:		_9 L	
Tolal:		_g	
C. Gross Weights Date 9/23/00 9/25/00	$\begin{array}{cccc} (1) & 106,528\\ (2) & \overline{106,52}\\ (3) &\\ \end{array}$	↓ Date	(4) (5) (6)
		Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	<u>106.5284</u> <u>106.5287</u> <u>0027</u> <u>9</u> <u>0017</u> <u>9</u> 0017 <u>8</u>
D. Net Weights: Remarks:			0
		Analyst	TB / Vo

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				<b>'o.:</b>		
Lab No		oy F. Weston, In		SEP-(Received	91	20/00
Clien	WUNK AF-M-LMF119-1-M202-1 Sampled: 13-SEP-00 Received: 19-SEP-00	2SEP2000-FHA, FI	Due: 26-3 LT #634, BHC,	BHS Dut:		9/24/00
	Received, 17 oct of			•		
Descripti	ion			Organ	ie Fro	tim
				0-		
A. Sam	ple Volume				50 mls	
		wash		1	So mis	Blank Correction
Total:	200	ml ×		g/ml		g
B. Tare	Weights					
		4.4621	9	<b></b>	Containe	r No.
	Filter		g			
	Thimble:		9			· ·
	Tolal:		_g			
	ss Weights			Date		
Date	9/23/00 (	$\begin{array}{c} 1) & 104.41 \\ \hline 104.41 \\ \hline 104.44 \\ \hline 3) \\ \hline \end{array}$	p3/ 528	·	(4) (5) (6)	
			Final Gros Tare Weig Residue V	ht: Veight:	104.462. 104.462. .000	9
D. Net	Weights:		Blank We	igni:		
	Remarks:					
					. 1	
				Analyst —	JB/	Vo

Lab No.: Client:	• • • • • • •	-1-8202-1	25EP2000-FHA 14:35	, Inc	ved		00 4/00	(1500 ites)
Description				probe	aceto	ne		
A. Sample	a Volume		wash	_100 75	m m	ls Is	Blank Correcti	on
Total:	125		_ml ×	3×10-4	_g/ml	. 000	. 4	g .
B. Tare W	Veights				*	•		
	Continer:	10a.	0758	9	Co	ntainer N	0.	7
	Filter:			_g				
	Thimble:			_9				
	Total:			_g				
C. Gross Date	Weights   	(1) (2) (3)	107.072	Dale 87		(4) (5) (6)		
D. Net W	/eights: Remarks:			Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	102.	6787 .0758 .0029 .0004 .0025	9	9 9
				Analyst	TMI	<i>] V</i> 0		

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Lab 1.40 1420093 196995 Roy F. West Clier ::: WUNK AF-M-LMF119-1-M202-12SEP2000-F Sampled: 13-SEP-00 : Received: 19-SEP-00 14:35 Description	Due: 26-SEP-0, Received THA, FILT #634, BHC, BHS I Out:	d <u>9/2</u> 9 1ter - 634	1/00 (1500) 124/00
A. Sample Volume		mls	Blank
was	sh		Correction
Total:ml	×9/	/m1	<u>8</u>
B. Tare Weights			-
Continer:	9	Container I	No.
Filter: 0.205	<u>a</u> 6 a		
Thimble:	g		
Total:	g		
C. Gross Weights Date <u>9/724/00</u> (1) 0.0 <u>1/25/00</u> (2) 0. (3)	Date	(4) (5) (6)	
- 0.00032	Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:		9
D. Net Weights: Remarks:			
	Analyst	Imo / Vo	

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				-	- •• •				
Lab No.:	1420094	196995 Ro	y F. Weston,	Inc.	P	lved	·	9/20/00	
Cileni:	WUNK AF-M-LMF11 Sampled: Received:	19-2-M202-12 13-SEP-00 19-SEP-00	SEP2000-FHA, 14:35	Due: FILT #633,	26-SEP-0 ⁸ BHC, BHS			9/26/0	00
Description					[ nor	ganic	Fro	Tion	
-						J			
A. Sample	Volume					395	mls	•	
			wash				_mls	Blank Correc	tion
Total:	3	95	_ml ×	2×	10-50	g/m1 -		. 0010	ð
B. Tare W	leights	- -		•				*	
		113,5	717	g			Contair	ner No.	
	Filter:			g					
	Thimble:			<u>g</u>					
	Total:			a					
C. Gross ' Date	,		112 57	82	Date		(	4)	
	9  25/00 9  25/00	(1) - (2) - (3)	113,57	80	•		(	5) 6)	
				Final Gro Tare We	ss Weigh	t: <u>113</u>	.578	0	g
				Residue Blank W	Weight:		. 004 . 001	33	g
D. Net W	eights: Remarks	5:					. 00	53 g	à
					Analys	1 –	8	1/1	

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Lab No.: Cilent:	1420094 WUNK AF-M-LMF Sampled: Received:	196995 119-2-M202 13-SEP-0 : 19-SEP-0	Roy F. West -12SEP2000-FH 0 : 0 14:35	on, Inc. Due: 26-SEP-0 HA, FILT #633, BHC, BHS	ved	9/20/00 9/26/00
Description	n			0.	rgante F	laction
. A. Sampi	e Volume				<u>35</u> mls	
			wash		150 mls	; Blank Correction
Total:	[8	\$5	_ml x		_g/ml	<u> </u> 9
B. Tare V	Weights					
	Continer:	117.	1329	g	Cont	ainer No.
	Filter.			_9		
	Thimble:			_9		
	Total:			_g		
C. Gross Daie	Weights 9   23   0 c 9   23   0 c	(1) (2) (3)	117.1345			(4) (5) (6)
. <i>.</i>		-		Final Gross Weight Tare Weight: Residue Weight: Blank Weight:	: <u>117.13</u> <u>117.13</u> . 01	29 9
D. Net W	Veights: Remarks:					
			· .	Analyst	JB	1 1/2

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Lab No.: Clieni:	1420094 WUNK AF-M-LMF11 Sampled: Received:	196995 19-2-M20 13-SEP- 19-SEP-	Roy 2-125 -00 00 1	F. Weston, EP2000-FHA, 4:35	Inc. FILT	Due: #633,		ved	15/9 6  f	100 14   e 0	.(1500)
Description									arotono		-
- A. Sample	Volume			wash			9 2 5	5	mls	Blank Correctio	n
Total:	(7	20		ml ×		3X	.16-4	_g/ml		004	Q
B. Tare W	leights	•								-	
	Continer:	117	1.18	114	_9			<b></b>	Container	No.	7
	Filter:				_9						
	Thimble:				_9						
	Total:	_			_g						
C. Gross Date	Weights 	<u>)</u> (	1) 2) 3)	117.18	36	/	Dale		(4) (5) (6)		
					Ta Re	are We esidue	oss Weight: eight: Weight: /eight:		117.1835 117.1814 .0021 .004		ð ð
D. Net W	leighls: Remark	s:							• o cj *	)	
	73						Analyst		im) / Vé		

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		<b>7699</b> 5 R			· –				
Client:			by F. Weston,	Inc.	cal	ved	9/21/	00	lisoi
	WUNK AF-M-LMF119 Sampled: 13 Received: 14	-2-M202-1  -SEP-00  -SEP-00	25EP2000-FHA, 14:35	Due: FILT #633,	26-SEP-04 BHC, BHS It:		9/	26/00	
					P	ilter	-633		
Description									
– A. Sample	Volume						_mls		
			wash			<u></u>	mls	Blank Correctior	I
Total:			ml ×			g/mi -			_ð
B. Tare W	eights					-	•••		
	Continer:			9		<b></b>	Container	No.	1
	Filler.	0.200	016	<b>.</b> 9					
	Thimble:			_g		L			
	Total:			_9					
C. Gross V Date	Weights	(1)	0,198/1	$\hat{\mathbf{u}}$	Dale		(4)		
	4125100	(1) (2) (3)	0. 19 80	<u>*</u> }			(5)		
	-	- 6.00	206 g	Final Gr Tare We	oss Weight:				_8 8
			-		Weight:				ð
D. Net We	eights: Remarks:								
					Analyst		100		

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Lr ¹ 1420095 C: WUNK AF-M-LMF Sampled Baceiver		Roy F. Weston, Inc. -125EP2000-FILT #635 ) : 0 14:35	Due: 26-SEP-C	Pro. No.: ⁾⁽ Date Rece l Date Out:			100	(1200)
Descriptio					Filt	e( -(o	35	
A. Sampl	le Volume		<u></u>			_mls		
		wash	<b></b>	·		_mls	Blank Correction	
Total:	<u></u>	ml x			_g/ml -	••••••••••••••••••••••••••••••••••••••		g
B. Tare V	Veights		-					-
	Continer:		g `		<b></b>	Container	No.	1
	Filter:	0.19854	g					
	Thimble:		9					
	Total:		g					
C. Gross Date	Weights <u>9/22/00</u> 0125/00	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	7000 1699	Date		(4) (5) (6)		
	- 0	. 00148 g	Final Gro Tare We Residue Blank W	Weight:				_0 _0 _0 _0
D. Net W	eights: Remarks	: 						<b>-</b>
				Analyst	<u>Juni)</u>	/ ı	γ	-

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Labt			Pro. No.:		9/20/00	
Clier	1420096 1969 WUNK COMP: AF-M-LMF1 Sampled: 13-Si Received: 19-SE	19-1-3-M202-125EP2000	Due: 26-SEP-0 -FILT #633, 634, 'Out:		9 0 0/14	
Descript		P ⁻ 00 14:35	635 F.H.	, _ [#] 63	3 - 638 - 635	- 5
A. Sam	ple Volume		1.0-0		mls	-
<u></u>		wash			mls Blank Correctio	n
Total:		ml x		_g/ml -		_g
B. Tare	Weights	-				
	Continer:	0.2 0016	_9		ontainer No.	٦
	Filter	0.20524	_9		Untamor Ho.	
	Thimble:	0.19854	_9			
	Total:	0 60396	_g			
C. Gros Date	s Weights		Date		(4)	
	<u>4126100</u>	(1) $0.5990$ (2) (3)			(f) (5) (6)	
	- (	0.00430g	Final Gross Weight: Tare Weight: Residue Weight: Black Weight:			9 9 9 9
D. Net	Weights: Remarks:		Blank Weight:			
			Analyst	TH I	1 00	



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Lab No.: Client:	WUNK	196995 Roy F. West 19-1-M202-12SEP2000-F 13-SEP-00 : 19-SEP-00 14:35	Duet	26-SEP-Ord BHC, BHS L	 9	0/05 26/0
Description				Inorg	anie F.	collor
A. Sample	Volume			(	410 mls	
		wash			mls	Blank Correction
Total:	410	ml ×	2×10-	♀g/ml	0	<u>008</u> g
B. Tare V			~		•	
	Continer:	115.914]	_9		Container	No.
	Filler:		_g			
	Thimble:		_9			
	Total:		_g			
C. Gross Dale	Weights 9 23 00 9 25 00	(1) $115.918$ (2) $115.91$ (3)	2	)ate 	(4) (5) (6)	
			Final Gross Tare Weigh Residue W Blank Weig	nt: eight:	115.9182 115.9141 · 0041 · 000	<u>م</u> الي المراجع المراجع المراجع ا المراجع المراجع
D. Net V	Veights: Remarks:					0
				Analyst	TB /VO	

Lab No. Clieni:	1420097 196995 WUNK AF-N-LMF119-1-M2 Sampled: 13-SEI Received: 19-SEF	Roy F. Weston 02-12SEP2000-FH 0-00 : 0-00 14:35	Ťe	: 26-SEP-Oceived ; BHC, BHS I:		26/00
Description	1			0,0	ance Fro	tion
A. Sampl	e Volume	wash			26 mls 150 mls	Blank Correction
Total:	170	ml x		رم م	ml	9
B. Tare		01.5887	9 9 9		Containe	er No.
C. Gros Date	ss Weights 9   25   06 9   25   06 		Tare Res	Dale I Gross Weight: Weight: idue Weight: nk Weight:	(4 (5 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	5) 5) 5) 5/ 7
D. Net	l Weighls: Remarks:					
	5			Analyst	JB	1/8

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Lab No.:			Roy F. Weston,		lued	9/21/00	(1500)
Client:	WUNK AF-N-LMF11 Sampled: Received:	9-1-M202- 13-SEP-00 19-SEP-00	12SEP2000-FHA, 14:35	Due: 26-5EP-09 FILT #632, BHC, BHS l		9/26/0	6
Description					shope a	otore	
A. Sample	e Volume		wash	- 8.9	m	Dhak	tion
Total:	110		ml ×	3×10-4	_g/m1	.0003	>Q
B. Tare V	Veights			-			
	Continer:	108	.6822	9	Co	ntainer No.	
	Filler.			g			
	Thimble:			_9			
	Total:			្ទ			
C. Gross Date	Weights <u>972273</u> 9733/00	<b>*</b>	108.68	Date 74		(4) (5) (6)	
				Final Gross Weig Tare Weight: Residue Weight: Blank Weight:	108.	6839 6822 6017 0003	9 9 9 9
D. Net V	Weights: Remarks	::				· 0014 g.	
i				Analy	si <u>TMD</u>	V1	

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Lab No.:  Client:	. 1420097 	196995 Roy F. Wes 119-1-M202-125EP2000 d: 13-SEP-00 d: 19-SEP-00 14:35	Due: 26-SEF -FHA, FILT #632, BHC, B			100 (1500) 127/00
Description	n <u>–</u>		F	ilter-6	22	
A. Sampl	e Volume	wash			mls mls	Blank Correction
Total:		mi x		_g/ml -	•••••	g
B. Tare V C. Gross Date D. Net W	Continer: Filter: Thimble: Total: Weights 9/22/00 9/22/00 9/22/00	0.20136 (1) 0.199: (2) 0.1497 (3) -0.00163g	_9 _9 _9 _9 _9 _9 _9 _9 _9 _0 _9 _0 _9 _0 _0 _0 _0 _0 _0 _0 _0 _0 _0 _0 _0 _0		(4) (5) (6)	Vo.
			Analyst	TMD	<i>[ U</i> ¥	

			⊡ <b>*</b> '∩,;		
Lab No. Client:		Roy F. Weston, Ind 2-12SEP2000-FHA, FI 00 00 14:35	Duer 26-SED-0		20/00
Description	۰ ۰		Or	o Inaga	nic Froillo
A. Sampl	e Volume			4 SO mis	Blank
		wash		mls	Correction
Total:	450	mi ×	2×10-4	_g/ml -	. 0009 g
B. Tare	Weights		-		
	Continer: 11	7.1748	g	Containe	er No.
	Filter.		9		
	Thimble:		9		
	Total:		9		
C. Gross Dale	s Weights 9  23/00 9  25/04	(1) 117,1780 (2) 1 <u>17,1787</u> (3)	Date	(4 (5 (6	)
			Final Gross Weight Tare Weight: Residue Weight: Blank Weight:	117-1780 	9 2 9 7 9
D. Net	Weights: Remarks:				
	9		Analys	JB/	Vo

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			Pro. No.:			
Lab No.: Client:	1420098 196995 WJNK AF-N-LMF119-2-M202- Sampled: 13-SEP-00 Received: 19-SEP-00		nc. ecel Due: 26-SEP-0 ILT #631, BHC, BHS ut:	ved _	9]2 9	000 126/00
Description	n		01	ganie	Front	loc
A. Sampl	e Volume	wash			mls mls	Blank
Total:	210	ml x		_g/ml -		Correction
B. Tare V	Weights	<b>.</b>				*
	Continer: 104	1.7/18	g	C	Container N	10.
	Filter:		9			
	Thimble:		g			
	Total:		9			
C. Gross Date D. Net V	<u>4/25/00</u> (1 <u>9/25/00</u> (2 (3	) 104.713	Date O Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:	 	(4) (5) (6) .7/30 .7/18 .0012	9 9 9 9
			Analyst	JB	100	

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Lab No.:  Client:	- 60 (NR/	76995 Roy F. Westc -2-M202-12SEP2000-FH 3-SEP-00 : 7-SEP-00 14:35	Dug. 26-	- _{SEP-0} /d С, вня I	9/21/00 9/24/0	
Description			<b>D</b> (	robe a rost	re	
A. Sample	e Volume	wash	7		mls mls Blank Correct	ion
Total:	200	ml ×	3×10-4	g/ml -	. 0006	g
B. Tare W				*		
	Continer: 10	7.1927	]	C C	Container No.	
	Filter.	(	9			
	Thimble:		3			]
	Total:		9			
C. Gross Date	9/22/05	(1) $107.19$ (2) $107.195$ (3)	5Z 55 .		(4) (5) (6)	
D. Net W			Final Gross We Tare Weight: Residue Weigh Blank Weight:	107	. 1957 - 1927 - 0075. - 0004 - 0004 - 0019	0 0 0

Analyst

JMD /Va

_ab No.:  Clieni:			Roy F. Wes 02-125EP2000 -00 -00 14:35	Due: 26-SE FHA, FILT #631, BHC, 1	BHS	<u>_</u>	<u>60 (150</u> 27/00
Description	۱ -				Filter	-63	
A. Sample	e Volume					mls	
			wash			mis	Blank Correction
Total:			_ml ×		_g/ml -		QQ
B. Tare V	Veights			*			
	Continer:			g	r	Container	No.
	Filler:	0.20	183	<b>9</b>			
	Thimble:			9			
	Total:			9	•		
C. Gross Dale	Weights <u>9 27/00</u> <u>1 25/00</u>	() (1) 2 (2) (3)	0.1973	Date 7		(4) (5) (6)	
		. 0. 00	4448	Final Gross Weight: Tare Weight: Residue Weight: Blank Weight:			U
D. Net W	/eighls: Remarks	:					
				Analyst	<u> </u>	0/10	)

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WUNK AF-N-LMF1 Sampled: Received: Description	19-3-M202-129 13-SEP-00 19-SEP-00 1	y F. Weston, Inc. GEP2000-FILT #630 4:35	Due: 26-SEP-0	Date Out:		9	100   27/a	(1500)
A. Sample	Volume	wash				mls mls	Blank Correctior	1
Total:		ml ×			_g/ml -			_ð
B. Tare W	/eights						<b>.</b>	
	Continer:		g			Containe	r No.	]
	Filter:	0.90432	g					
	Thimble:		g					
	Tolal:		g					
C. Gross Date	Weights <u>9 22()()</u> <u>1/25(20</u>	(1) $0_{1} 20$ (2) $0.20$ (3)	188	Date		(4) (5) (6)		
	- 0	00240 g	Tare W Residu	ross Weight /eight: e Weight: Weight:				ð ð ð
D. Net W	leights: Remarks:							
				Analyst	TM	0 / Vi		



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Lab N:	1420100 196995	Roy F. Weston, In	o.:	••••••••••••••••••••••••••••••••••••••		1
Client	WUNK COMP: AF-N-LMF11 Sampled: 13-SEF Received: 19-SEP	9-1-3-M202-12SEP2000 0-00 : -00 14:35	Due: 26-SEP-Qece )-FILT #630, 631, 1 #637- )ut:		9]3 9]	0100 01/00
Descripli	on		Fil	tec # 63:	) - 63	1-630
A. Sam	ple Volume			r	nis	
		wash		I	nls	Blank Correction
Total:		ml ×	<u></u>	g/m1		g
B. Tare	Weights			-		
	Continer:	0.20136	g	C	ontainer N	lo.
	Filler	0.20183	g		Untainer r	
	Thimble:	0.20432-	g			
	Total:	0-60751	-			
C. Gros	ss Weights		Date			
Date	<u>4/26/0</u> 0 9/24/00	(1) $\underline{0-600}$ (2) $\underline{0.5997}$ (3)	43	· 	(4) (5) (6)	
۰.	_ 0	00820	- Final Gross Weigh	t:		g
,			Tare Weight: Residue Weight: Blank Weight:			9
D. Net	Weights: Remarks:					
			Analys			
			Analys		5	



421165	196995 Roy F. Weston, Inc		e Analysis Pro. No:		
WUNK ilter W64		Due: 10-0CT-0	Date Received:	9/29/00	(1510)
Sampled:	28-SEP-00 16:00	ļ	Date Out:	10/2/00	Vo
	Description:		14ER # 646	)	
	A. Sample Volume:	· · · · · · · · · · · · · · · · · · ·	mls		<b>Wash</b> (mls)
				Blank C	orrection
	Total:	mix	g/ml		9
	B. Tare Weights:				
	Container:		g		
	Filter:	0.20166	g		<b>.</b>
	Thimble:		9	•	
	Total:	<u></u>	g		
	C. Gross Weights: Date प्रि <i>श्विः</i>	(1) 0,202	3/ Date	10/2/00 (3)	0.20149
	10/2/00	(2) 0 · 701	ifter	, (4)	
		0.20146	Final Gross Weiç	jhts:	g
	+ . 00065	- 66019 aftr	Tare Weight:		g
	D'effore III J	after Drygg	Residue Weight:		g
			Blank Weight :		_ g
			Residue Weight:		_ 9
	D. Net Weights: Remarks: _				

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Particula	te Analysis	
Lab No:	Pro. No:	
1421166 196995 Roy F. Weston, Inc.	P-0 Date Received: 9/24/00 (	510)
WUNK DUE: 29-50 Filter W647 Sampled: : Received: 28-SEP-00 16:00	Date Out: $ o \partial O$	VO
Descriptio <u>n:</u>	Filter # 647	
A. Sample Volume:	mls	Wash(mls)
	Blank Co	prrection
Totai:ml x	g/ml	_ g
B. Tare Weights:		
Container:	9	
Filter: 0.20071	9 ~~	
Thimble:	9	
Total:	g	
C. Gross Weights:	a las	
Date <u>9/29/00</u> (1) <u>0.20</u> 10/2/00 (2) 0 20	$\frac{5130}{060} \frac{B}{A} \int Date \frac{10}{2} \frac{10}{60} (3)$	020065
100136 12001 100000 17000	Final Gross Weights:	g
+ .00059g00011g Before after Dryng Dryng	Tare Weight:	g
Duging Duging	Residue Weight:	g
	Blank Weight :	g
	Residue Weight:	g
D. Net Weights: Remarks:		
Nemdi N3.		

1167 196995 Roy F. Wes	Particulate	Pro. No:		
NK ter W648 mpled: eived: 28-SEP-00 16:00	Due: 29-SEP-0 1 Bottle 50A of 00	Date Received:	10/0/00	(0125) VD
Description:	<i>[</i> -	Filter # 648	Ś	
A. Sample Volume	e:	_mls		Wash(mls)
			Blank Co	orrection
Total:	mi x	g/ml		_ g
B. Tare Weights:	· · · ·			
Contai	ner:	_g		
Filter:	0.20092	g_		
Thimbl	e:	_g		
Total:		ĝ		
C. Gross Weights	:	In	·	
Date <u>9/89</u>	<u>loo (1) 0.201</u>	50 Dry Date 1	0/2/00 (3)	02007
10/2/0	$\frac{1}{100} (1) \frac{0.201}{0.200}$	- ny -	(4)	5
120150	120092	Final Gross Weight	s:	g
+.00058	- 100018 after	Tare Weight:		_ g
+.00058 Defne DMJ	Orgy	Residue Weight:		g
U	v	Blank Weight :		g
		Residue Weight:		g
D. Net Weights: Remark	(S:			